STRATEGY RESEARCH PROJECT

HUBRIS, WARRIORS AND EVOLUTION

BY

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USAWC CLASS OF 1999

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ABSTRACT

AUTHOR: Captain Manuel Ambrosio Malagón-Fajar, USN

TITLE: Hubris, Warriors and Evolution

FORMAT: Strategy Research Project

DATE: 11 May 1999 PAGES: 126 CLASSIFICATION: Unclassified

In the late 20th century man's creativity has blossomed. Nanotechnology, biotechnology and other fields reshape microbes, man and the environment. Robots will soon follow. However, genocide still reigns. How can such contradiction, such brilliance and madness, be embodied in man? To unveil man is to understand a paradox of innovation and murder; to envision how nature brought about change in man is to fathom evolution; and, to understand adaptive change is to see man as a patchwork of evolutionary effects. This paper shows that emotions, brains, men, and armies are linked complex adaptive systems. It describes how emotions underpin a 'Risk Contract of War' that allowed war to become an adaptive evolutionary strategy with significant current and future human implications. Hubris and warriors are shown to be emotional and physical evolutionary products still present in man; and therefore, the strategic battleground extends backwards from technology to man's psychological and emotional roots—war remains a Clausewitzian clash of wills.

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ACKNOWLEDGEMENTS

Thanks to many others. RADM Albert Konetzni, USN sent me to the U.S. Army War College (AWC). MGEN Robert Scales, USA preserved an AWC framework for intellectual discussions on war. Dr. Douglas Johnson and Prof. Williamson Murray provided an atmosphere of challenging debate on military innovation and adaptation. Dr. Kent Butts and Dr. John Goss, III guided me to resources in the environmental and anthropological fields. Prof. Patricia Pond and Dr. Herb Barber stimulated thinking about organizational behavior and human psychology. Dr. Johan Van der Dennen assisted with his well-organized web site and books. Mr. Jeffrey Millington encouraged and prodded me.

The U.S. AWC library staff, Ms. Jane Gibish, Ms. Patsy Myers, Ms. Jacqueline Bey, Ms. Ginny Shope and Ms. Mary Rife helped with research tools. My wife Eva and parents Dr. Ambrosio and Elsa Malagón allowed me to immerse myself with the obsession this subject has become. And, Ms. Kathy Bernd patiently assisted with the quirks of computer editing.

The flaws are mine.

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HUBRIS, WARRIORS AND EVOLUTION

> *The Mohammedan conquest of India is probably the bloodiest story in history. It is a discouraging tale, for its evident moral is that civilization is a precarious thing, whose delicate complex of order and liberty, culture and peace may at any time be overthrown by barbarians invading from without or multiplying from within.*[1]
>
> — Will and Ariel Durant

Allan Nevins warns that "any important historical transactions should be treated as of multiple causation, its roots as numerous and far-ramifying as its consequences . . ."[2] The topic of evolution mandates a broad view: not threads or strands, but cords. It is by nature interdisciplinary—biology, sociology, psychology, physics, anthropology, ecology, economics and history—all slices of a process operating simultaneously at multiple levels. And, though it is impossible to master all the tools or examine all the details, glimpses of important patterns and trends emerge. Context matters.

This paper sketches the evolutionary interaction of man with man. Hubris and warriors are shown to be evolutionary results.[3] The chiaroscuro describes methods for analyzing man's current quandary. Two tools, evolution and complex adaptive systems, are used to describe the interaction of man shaping man—and how the tension between man's emotions and reason creates an enduring paradox.

HISTORIC BACKDROP

Without energy, men or machines die. Life's complex patterns emerge from self-organizing information-mass webs driven by an energy flux. Energy agitating information and mass creates a web of life. Energy's evolutionary role as the spark of life is assumed in this discussion.

Evolution is a process of descent with modification and selection. Ten thousand years ago a wolf had six pups, two were captured by man, and one reproduced in the wild. The two captured pups bred in captivity and each generation afterwards man culled the wildest and kept the tamest. Dogs became symbiotes with man—keen scent and ear aided man to hunt and warn—today there are hundreds of dog breeds, but the wild wolf is nearly extinct.[4]

This simple paradigm describes interactive changes in microbes, man, culture and war. Evolution is a mechanism akin to the historic process in its irreversibility and dependence on context—it is a powerful analysis tool for political, organizational, historic, economic, biologic and military issues.

Once life replicates and fills an ecological niche then strategies emerge—breed, compete, cooperate, or change—to control and gain access to energy and resources. These strategies channel evolution. A dynamic tension between cooperation-for-

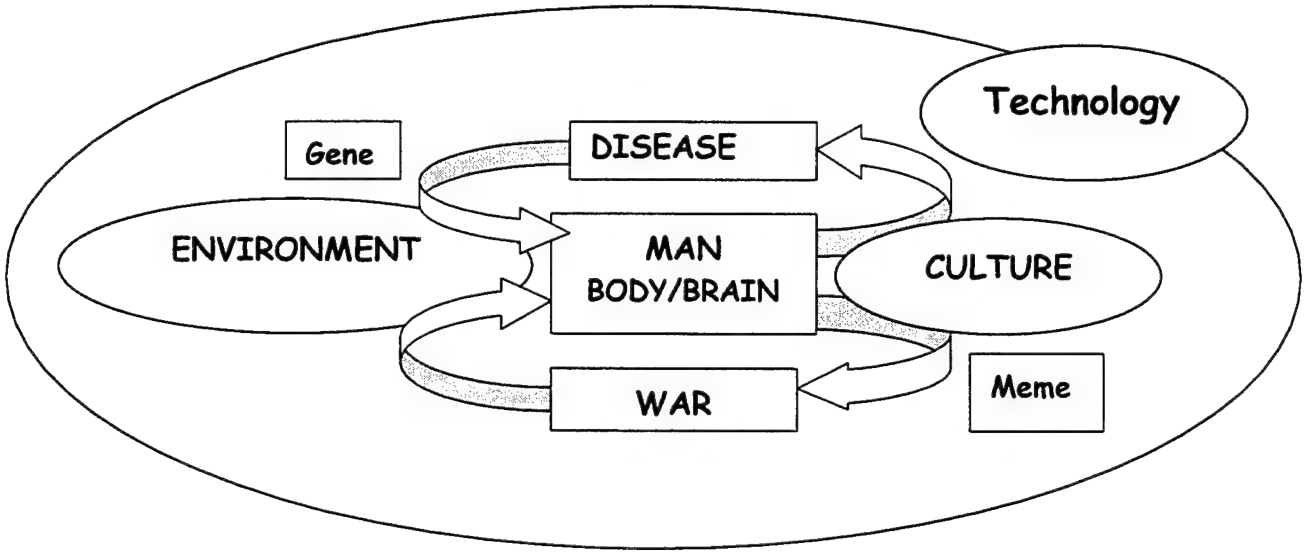

Figure 1 — Inner & Outer Forces Shape Man

competition and competition-through-cooperation creates new structures for processing resources and information.

Cells emerge from the union of two previous bacterial antagonists, language from intra-group cooperation and sex to protect genetic information.[5]

Conflict or cooperation cascade and ripple throughout all size scales—protein, virus, cell, organ, man, group, society, ecology, or planetary—and create complex causal chains allowing existence amidst the struggle for energy and reproductive success. Evolutionary sieves direct selection pressures.

Disease and war shape man, but man shapes bacteria and culture—this in turns changes the environment—a dragon eating its tail. Interacting agents form webs—action links and structures that adapt. Bones, muscles and nerves are inescapable products of biologic evolution at the micro level as are roads, carts and

signals at the macro level.[6] Links form a syntax, communication through patterns and the creation of language.

Reproduction is a data exchange process. Data transmission can occur as antibiotic resistant bacteria share their genetic information with viruses and bacteria; or, among insects by swapping k-d-r genes imparting pesticide resistance to other insects.[7] This exchange enhances fitness through cooperative sharing of biologic information. Information creates identity. Under selective pressures organisms with drastic phenotype changes emerge in a few generations.[8] Inter-species signals and communication enhance fitness by increasing the individual's range of connectivity and information. Data storage and transmission mechanisms evolve internally and externally. Data processes into information, information into knowledge, and knowledge into wisdom—predictive patterns enhancing survival. For humans the processing and exchanging of information leads to a complex web of instincts and emotions that allows group activities to move beyond herd-like defense to hunting, language and culture. The positive feedback created by cultural pressure—especially mate selection and coalition warfare—forces rapid brain development and further adaptation to cultural pressures. Behavior evolves from reflexes to instincts, to emotions, and then ideas. The results are a quixotic human nature—a patchwork marionette of impressions and thoughts tugged by emotions.

The evolutionary trajectory modifies both the organism and ecology.[9] Today, as man changes nature, the levels are irrevocably intertwined: bacteria that eat crude oil are enhanced genetically; frost-resistant strawberries are bioengineered; genetically manipulated cows grow pharmaceuticals; HIV is tooled to fight HIV; insecticides force the cotton moth to eliminate fundamental structures;[10] and so forth—innumerable interacting echoes. The start of the 21st century is humanity's critical evolutionary inflection point. However, as 1st tier countries reconstitute humans and colonize Mars, terror and conflict will continue in the world. New modes of armed combat and social upheaval will emerge—genetic and software wars, crop-busters, man-killers, animal-destructors,[11] terrorism, anarchy and plagues—evolutionary forces on an unprecedented scale. The agent is man—creator and destroyer.

THOU SHALT NOT MURDER

> *And the Lord had respect unto Abel and to his offering: But unto Cain and to his offering he had not respect. And Cain was very wroth, and his countenance fell.*
>
> *And the Lord said unto Cain, Why are thou wroth? And why is thy countenance fallen? If thou doest well, shalt thou not be accepted? And if thou doest not well, sin lieth at the door. And unto thee shall be his desire, and thou shalt rule over him. And Cain talked with Abel his brother: and it came to pass, when they were in the field, that Cain rose up against Abel his brother, and slew him.*[12]
>
> — Genesis 4:2-4:12

The struggle between Cain and Abel was written on a goatskin when the Sahara was turned into a desert by climate change and

overgrazing. It underscores the struggle between shepherds and farmers; the impact of man on the environment; the impact of the environment on conflict; the need for justice to solve conflict; the rule of passion over reason; and, the need for enforcement to preserve peace. Cain, the first murderer, also founded the first city.[13]

The Apocalypse's four horsemen are legion: genocide—Rwanda, Algeria, Cambodia & Yugoslavia; famine—Sudan, Somalia, Ethiopia & China; epidemics—India & Africa; drought and floods—Sudan, Nicaragua, Bangladesh & China; water shortages—Gaza-Israel-Jordan, Syria-Turkey-Iraq, Iran-Afghanistan, Pakistan-India & Egypt-Sudan; toxic effects—Minamata, Aral Sea & Russia; desertification—Australia, Mahgreb & Central Asia; mass migrations—worldwide; and, war and conflict—Yugoslavia, Algeria, Sudan, Central Africa, Colombia, Iraq & Mexico.

The unifying agent in this tragedy is man, a creature that is as much the creator of the maelstrom that buffets him as its product. Of three anthropocentric views—man's affect on the environment, man's effect on man, and the environment's effect on man—only man-on-man pressures will be examined.[14] And to reverse engineer man an understanding evolution and adaptation will be developed, this allows dissecting man's behavior and examining the tension between man's implicit models, instinct and emotion, and his explicit models, thought and language. An evolutionary

background shows how hubris and war emerge from man's cacophonous emotional symphony.

COMPLEX ADAPTIVE SYSTEMS (CAS)

> *But though these people raved they were not mad. They were making the only noises they knew to express the misery inflicted on them by the economic collapse of the Western Roman Empire. Since there was no economic literature there was no vocabulary suitable to their misery, so they had to use the vocabulary given to them by the Church; and they screamed nonsense about the sacraments because they very sensibly recognized that the Western Roman Empire was going to die, and so were they.*[15]
>
> — Rebecca West
>
> *I am convinced that the nations and people who master the new sciences of complexity will become the economic, cultural and political superpowers of the next century.*[16]
>
> — Heinz Pagels

Lack of vocabulary created the schismatics's difficulties; so, to avoid them a few definitions are in order, especially complex adaptive system (*cas*) and evolution, conceptual tools that allow examination of the complex interrelationships that shape man. *Cas* concepts provide a framework for understanding bacteria, brains, man and society—the agents that evolve. A *cas* example, an army, is presented followed by adaptive agent and *cas* property descriptions.

An army is a constrained *cas*, especially in peacetime, when hierarchic limitations restrain evolutionary possibilities.[17] An army has many *cas* elements. Soldiers aggregate into platoons, battalions, brigades, divisions, armies and corps. Rank and specialty designations facilitate assembling aggregates and interactions. Uniforms identify members bonded in the Risk Contract

of War—the agents composing the *cas*. Orders and signals use evolved military terms to realize further efficiency. Tactical, operational and strategic hierarchic levels emerge at different aggregate sizes. Flows include fuel, ammunition, men, fires and signals. Soldiers and units are agents acting on and in turn acted upon by flows.

Diversity in arms from infantry to helicopters meshes to form a combined arms synergy greater than any single branch. Overt staff planning with branches and sequels is implicitly implemented through trained troops and human nature. Soldiers, who once fought for women, are motivated implicitly by awards and rank, as well as explicitly through rules and training.

Non-linear effects, from the emotional to the physical, run rampant throughout battle.[18] S.L.A. Marshall notes that "a band of men may go through a terrible engagement, take its losses bravely, and then become wholly demoralized in the hour when it must bury its own dead. A regiment, fretted to utter abjection by a protracted stay in the lines, may find its fighting spirit again in a six-hour respite during which the men are deloused and given a change of underwear."[19]

Selection, training and cultural processes—organizational lever points—shape an army. Values—duty, honor, courage, leadership, and loyalty—foster human bonds and create group cohesion.[20] Group sized units are potent, bonded fighting units.[21] An

army maintains coherency from peace to war by adapting while regulating critical variables—especially information and energy. Its ascendancy is inextricably linked to the environment—wartime or peacetime—it evolves in. And finally, its evolution is bound to the context of circumstances encountered before.

ADAPTIVE AGENTS

With the army *cas* example as a backdrop a synopsis of agent internal mechanics—especially the performance system or rule evaluator—follows with details of *cas* properties and mechanisms given afterwards. This section is based on John Holland's extensive work on emergence and provides a taste of the recursive and iterative nature of CAS.[22] The reader interested primarily in the evolutionary results of hubris and warriors can go directly to the section on evolution's effect on men and women (page 29).

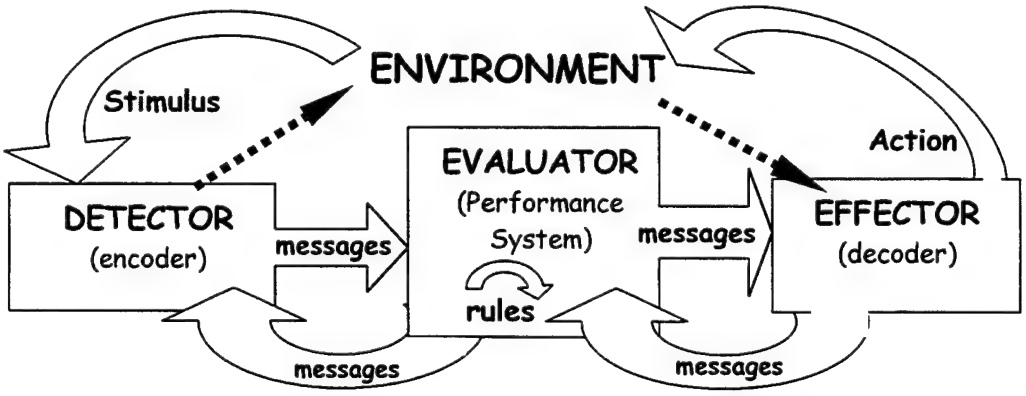

Figure 2 — Agent as Detector-Evaluator-Effector[23, 24]

Adaptive agents evolve without 'knowing' how they do it and without any central direction—genes, neurons, muscles, eyes, brains or humans are examples.[25] Individual agents are the evolutionary units in a *cas* ecology. A *cas* or adaptive agent maintains "coherence under change" through circular feedback that incorporates resource and signal importation from the environment, and effluent and signal exportation to the environment.[26] Continuous self-reference allows *cas* to maintain their identity through change without an outside architect.[27] *Cas* use self-generated rules (conditional action) and rule created models (anticipation) as adaptive mechanisms. An agent's internal mechanism generates a potential difference or payment that stimulates rules to evaluate messages and discover new rules. In other words, the performance system evaluates identity and effectiveness to credit rules that work well and then uses strong rules to create new rules.

A rule is a procedure or principle to determine results or actions. Rules can be stimulus-response actions or simple conditional IF-(AND-OR-NOT)-THEN statements. A syntax that forms a group of linked relations or stimulus-response actions permits rules to interact and determines their context. Some rules send messages from the detector, to the effector, or to other rules, while other rules evaluate messages.[28] Rules are embodied as data strings that can either be treated as raw material or as direc-

tive instruction. For example, DNA is either a set of master blueprints directing building construction, or a set of blueprints portions of which are copied to incorporate into a new set of master plans.

A detector can be plural: a bundle or ganglia or group of detectors. The detector generates messages that are evaluated by a performance system that is a collection of message processing rules. The performance system receives detector or effector signals; evaluates or applies syntax to messages and rules; directs action by the detector or effector; credits rules for their performance; and, generates new rules by recombining old rules. Rules are identified through tags or markers that emerge from patterns appearing in the rule's conditional or action part; and therefore, tags help bind rules or messages to one another through syntax. In other words, tags are targets for direct couplings and interactions, for example "if the agent is an antibody, the stimuli are the molecular configurations—tags—on the surfaces of the antigens."[29]

Rules can be thought of as hypothesis under continuous testing through competition for rewards.[30] The performance system uses a price system with payoffs analogous to a stock market to reward rule use. Rules whose 'IF' conditions apply can 'bid' to advertise their messages for sale in the expectation that a buyer will pay more than was 'bid'. Rule bids are proportional

to rule strength and specificity so that the more a rule gets used and the more directed its effects the stronger it becomes. Specific rules are 'paid' when a buyer uses their message or all currently active rules can be benefited when the 'stock market' is bumped up by receiving an infusion of 'cash' from the environment.[31] In other words, rules are implicit models that get verified through payments—for example, neurons or emotional ganglia are activated by stimuli, process inputs into results, are rewarded electro-chemically, and thereby gather strength.

Rules that set the stage for rules that directly obtain rewards from the environment, ultimate-rules, are also enriched since strengthening the ultimate-rule directly increases its bidding ability, thereby benefiting stage setting rules.[32] Chains of mutualism emerge where information is exchanged for value.

"What if the supplier rule sends a message that activates an ultimate-consumer rule, but 'cheats' by not appropriately setting the stage for the consumer's action?"[33] Cheating weakens the consumer because it paid without receiving a reward; therefore the consumer has less 'cash' to pay the cheater next time. Cheaters eventually become impoverished, especially if there are competitors offering alternatives to the consumer. Because rules exist in a daisy-chain context of competitive supply and demand with identification, cheaters are weeded out.[34]

General rules are used more often and correspond to default, reflexive conditions that compete with more specific rules. Specific rules are added with time as experience is gained.[35] E.g.,

Default: IF[(moves)(no_size)(no_distance)]—THEN[(danger)]

IF[(danger)(no_size)(no_distance)]—THEN[(move)(away)]

Specific: IF[(moves)(small)(close)]—THEN[(probable)(food)]

IF[(probable)(food)]—THEN[(move)(closer)]

The tension between general and specific rules creates paradox, but the broad and the narrow become symbiotes since general action leads to diffuse behavior that dissipates the organism's energy, therefore specific, context-rich rules are valued.[36] Strong rules become building blocks for generating new, untested rules and in this fashion the performance system generates anticipation and innovation.[37] In other words, strong rules are identified and portions used in a combinatorial fashion to create new hypothesis—a model of the environment emerges from tagging and assembling rules. Modeling in turn gives the agent flexibility. Performance systems are collections of self-modifying rules that use past success to evaluate the present and generate hypothesis for the future, thereby forming the core of adaptive units and giving *cas* their unique features.

PROPERTIES AND MECHANISMS[38]

A *cas* has seven basic elements that allow it to evolve. Three mechanisms—tagging, modeling and assembling—create four

properties—aggregation, non-linearity, flows and diversity. The *cas* concept is today's zeitgeist. Note the parallels between John Holland's *cas* features and Gerardo Ungson and John Trudel's broad guidelines for corporate prosperity: simplicity may not work (non-linearity and building blocks); complexity matters (aggregation); think organically (flows); reengineering management is not a panacea (flows and modeling); recognize individuality (diversity & tagging); institutions count (modeling).[39] What is seldom pointed out is that the elements that make *cas* adaptive can also lead to unpredictable and sudden collapse. A closer examination of *cas* elements follows.

Bee swarms, ant colonies, mammalian brains, and human cities emerge from individual agent—bee, ant, neuron or man—interactions. Those diverse collective entities possess four traits: aggregation, non-linearity, flows and diversity. Aggregation or swarming is typical of *cas*.

Aggregation

The result of multiple agents interacting is often an observable aggregate behavior distinct from individual behaviors. Aggregates usually result in hierarchies. For example: organelles, cells, organs, man, city and civilization. In many cases a *cas* can be decomposed into parts which are also *cas*—human, nervous system, brain, amygdala and neuron. However, higher *cas* assemblies usually have properties not predictable from lower

cas element behavior. Aggregates and their properties are used to model *cas*.

Cas representations are based on aggregate properties. Aggregates lend themselves to modeling because a good model eliminates trivia and incorporates essence, the fundamental *cas* properties, those that emerge as characteristic. Emergence, behavior not implicit in the rules of a system, is a fundamental property of complex adaptive systems.[40] Ronald Fox states that "emergent properties are characteristics of nonlinear, driven, dissipative systems . . . [and] appear in at least three distinct ways: self-assembly, autocatalysis, and self-organization. Each manifestation is a consequence of energy flow; however, energy flow alone is not sufficient because the particular energy type and the particular substances involved determine the emergent properties."[41]

Example emergent properties are wars and storms. Other examples are invariant features that exist across all human cultures—"prestige and status, inequality of power and wealth, property, inheritance, reciprocity, punishment, sexual modesty, sexual regulations, sexual jealousy, a male preference for young women as sexual partners, a division of labor by sex, . . . hostility to other groups, and conflict within the group, including violence, rape, and murder."[42]

Aggregates, in turn, become meta-agents operating at a higher hierarchic level. An important feature of aggregates is that the whole is greater than the sum of the parts—they produce novelty through their agent interactions.

Non-Linearity

Temperature or velocity is an average measure obtained by a linear summation of the property over all the individual parts. In contrast, *cas* behavior is more than the sum of the parts. For example, even though ants possess a limited behavioral repertoire, a colony's actions cannot be understood by statistical analysis.[43] Even so, John Holland points out that "we *can* reduce the behavior of the whole to the lawful behavior of its parts, *if* we take the nonlinear interactions into account."[44] Non-linear effects are the result of multiple, parallel local individual agent interactions as seen in swarms and colonies.[45]

Flows

Resource movements through nodes via connectors create flows. Resources can be oxygen, mail, goods, orders, signals or men. Connectors can be capillaries, neurons, cables, roads or relationships. Nodes process resources—they are agents that include blood, neurons, organs, brains, soldiers, or platoons.

Tags or labels provide identity and implicitly direct interactions; thereby directing flows to target-agents, delimiting the agents composing the network, and framing the *cas* boundary.

"Tags acquire this role because the adaptive processes that modify *cas* select *for* tags that mediate useful interactions and *against* tags that cause malfunctions."[46]

Flows have two characteristics that tie back in with nonlinearity and lead to chains of reciprocity.

Multiplier Effect

The multiplier effect generates additional resource flows in a network for any given initial input. For example, a dollar spent generates several more dollars of spending as it ripples through the economy. Another example is the cascading effect of anger or fright on the human endocrine system. The multiplier effect "is relevant whenever we want to estimate the effect of some new resource, or the effect of a diversion of some resource over a new path. It is particularly evident when evolutionary changes occur, and it typically jeopardizes long-range predictions based on simple trends."[47] Besides increasing output through the distributive multiplier effect, *cas* conserve resources through recycling. This concept applies to rules, information or behavior.

Recycling Effect

Recycling increases output by conserving resources. For example, a tropical rain forest thrives in soil that leaches rapidly when farmed. In the rain forest cascading cycles nurture resources until they are finally surrendered to the river. Re-

cycling agents retain resources that can in turn be used by other agents creating further diversity.

Lever Points

Although *cas* preserve 'coherence under change', they can be very sensitive to specifically directed small changes due to their non-linear, cyclic and multiplier effects. For example the power level in a critical reactor is changed by controlling less than 0.1% of all the neutrons, the delayed neutrons—those with a slower birth rate. By controlling this small fraction of the neutron population a process with non-human time scales, micro-seconds, is manipulated by man. In man emotions are lever points—triggers that lead to rapid physiological changes.

Diversity

Agent variety enhances immune system, forest or army performance. "The mammalian brain consists of a panoply of neuron morphologies organized into an elaborate hierarchy of nuclei and regions; New York City consists of distinct kinds of wholesalers and retailers . . .. This diversity is neither accidental nor random. The persistence of any individual agent, whether organism, neuron, or firm, depends on the context provided by the other agents."[48]

John Holland states that "the patterns of interaction familiar from ecology—symbiosis, parasitism, mimicry, [and] biological arms races . . . are all well described in terms of agent-

directed flows of resources."[49] And so, as a consequence of agents adapting to exploit flows by linking into cyclic or multiplier chains, diversity arises.

Tagging, assembling and modeling allow *cas* to evolve. These three processes generate innovation and anticipation. They are the evolutionary triad.

Tagging

Prices, trademarks, flags, banners, faces, names, uniforms or arm patches are signals that improve interaction efficiency—they are patterns that act as targets—tags facilitate aggregates. "Well-established tag-based interactions provide a sound basis for filtering, specialization, and cooperation. This, in turn, leads to the emergence of meta-agents and organizations that persist even though components are continually changing."[50]

In other words, by permitting recognition, tags allow relationships to form, identity makes action and adaptation without central control possible. The market is a pervasive metaphor for distributed competitively driven interactions rewarded by individual payoffs. Recognition facilitates agent access and resource interchanges and favors agents connected in a chain of reciprocity—nepotism is rooted in identity and trust.

The ability to distinguish connections permits interactions that compose or decompose resources, affect pay-offs or punish-

ments, or give or deny information. Tags allow calls to sub-routines or LEGO™-like assembly of sub-components or rules.

Assembling[51]

Proteins, genes, neurons, sentences, laws, diodes, and men are building blocks. The Krebs cycle in biology is a building block used by most mobile organisms.[52] Nature and man assemble building blocks in combinations to continually innovate. Building blocks are tested sub-routines in software or proven sub-assemblies in hardware. Tag mediated assembly of building blocks permits model creation without a designer.

Modeling

Robert Fox considers that "the biological significance of the nervous system is that it can predict . . . Speed is not always the whole story in biology. Accuracy or fidelity is also important for survival."[53] In other words, brains are predictive mechanisms, models, for internal and external processes. A good model means life or death. The simplest, and most important, model is one generated by stimulus-response—the implicit model.

Implicit (Tacit)

A leaf turning towards the sun is a tacit model. It describes an ongoing action with an implicit or inherent expectation. Humans are aggregates of multiple implicit models. In man emotions are implicit models. Joseph LeDoux explains that "emotions deal with 'fundamental life tasks' . . .. [E]ach emotion

'prompts us in a direction which in the course of evolution has done better than other solutions to recurring circumstances' . . .. [E]motions involve situations that have occurred over and over throughout our evolutionary history (escaping from danger, finding food and mates) and cause us to appraise present events in terms of our ancestral past . . .. [T]he structure of the past imposes an interpretive landscape on the present."[54]

Reflexes, instincts and emotions are human implicit models. Another tacit model is the marketplace and prices. John Holland states that "figures of merit for *cas* are usually implicitly defined. Competition, with local payments, is one of the few techniques we have for handling such problems in distributed systems."[55] Feelings are another form of payment, price mechanism.

Explicit (Overt)

Implicit, reflexive models are complemented by reflective, explicit models. A computer evaluating chess moves is an overt model. It describes an exploratory process, lookahead, prior to undertaking action.[56] Human lookahead is limited—chess masters use patterns accumulated from experience to look at the most productive scenarios; therefore the power of language and mathematics as predictive human tools. Explicit models increase agent flexibility. Men use mental models to discern trends and influence events, but in most cases thoughts are layered on top of a web of reflexes, instincts and emotions. Most of man's world

model is non-verbal and irrational—thought is a small tip of a hidden iceberg.

The above discussion shows how *cas* rule creation and self-modification are the heart of evolution. Children are hypothesis to be tested.

EVOLUTION

> *For thus said the Lord God; How much more when I send my four sore judgments upon Jerusalem, the sword, and the famine, and the noisome beast, and the pestilence, to cut off from it man and beast? Yet, behold, therein shall be left a remnant that shall be brought forth, both sons and daughters...*
>
> — Ezekiel 14:21-22

This biblical passage describes an evolutionary process—descent with modification and selection. Such a process incorporates in it John Von Neumann's four principles for self-reproduction: a blueprint, a controller, a copying process and a factory.[57] A typical evolutionary recipe follows: 1) pick an agent's strong rules; 2) create copies and recombine them (achieved through sex or programming); 3) reproduce the detector-effector-structure using the new rules; and, 4) test the off-spring. If it survives repeat step 1. Note that evolution occurs inside agents as well (no step 3 involved) when old rules are combined to produce new ones—knowledge tempered by experience creates wisdom.[58]

Robert Ayres says that evolution maximizes "the ability to capture free energy and, most important, *to process it, utilize it, and convert it to morphological information embodied as structure or organization. To the extent that intelligence enhances this ability, evolution seeks to maximize intelligence.*"[59] In other words, the evolutionary process creates *cas* with increasing predictive capabilities.[60, 61]

Emergent properties of evolutionary processes are escalating complexity—informational and structural; competition—disease, war, and arms races; cooperation—mutualism, symbiosis, and parasitism; organism and environmental modification; and, for the maladapted, extinction. All size scales evolve: stellar, planetary, geologic, ecologic, biologic, or cultural. Human genetic evolution occurs in 10 to 100 generations whereas diseases change many times within a single human life span.

Feedback, often mutually reinforcing, underlies evolution. This idea, symbolized by the medieval uroboros—a snake biting its tail, "represents an entity that is self-generating and self-sustaining."[62] Co-evolution occurs on many levels with interlocking interactions. The human brain and throat allow language, but verbal expression allows selection for more capable brain and throat combinations.[63] War and disease change man and culture—in turn man's modified brain, body and culture change microbes and conflict.

The struggle for survival and reproduction over disease and dearth shapes man and society, and leads to a widened variety of crisis response mechanisms. Man survives because he adapts internally and externally.[64] His successful adaptation at the bacterial, human and social scales results in positive feedback loops on all levels. He creates artificial environments and exploits the natural environment. Groups, a *cas*, emerge for the enhanced protection, foraging, and mates they afford; and, in turn lead to conflict with strangers and competition-cooperation among neighbors.

In man, evolutionary results entrain past survival mechanisms into physical or emotional equipment; absorb current environmental pressures in phenotypic modifications from embryo to adult; and, allow for adult adaptation through the intellect.

CULTURAL EVOLUTION

War and disease, the great shapers of innovation and change are now influenced by culture.[65] Arthur Koestler said that, "continuity-through-change and unity-in-diversity seem to be the pre-condition of a living culture."[66] John Bonner defines culture as "the transfer of information by behavioral means, most particularly by the process of teaching and learning. It is used in a sense that contrasts with the transmission of genetic information passed by the direct inheritance of genes from one generation to the next."[67] John Goss refers to culture as "what we say

we are."[68] In 1976 Richard Dawkins coined the idea of a cultural counterpart to a gene—the meme.

Dawkins deliberately uses the idea metaphorically and John Bonner limits it only to "any bit or any collection of bits of information passed by behavioral means from one individual to another."[69] However, he distinguishes them as follows: 1) Genes are transmitted chemically. Memes are transmitted by teaching and learning through various means—touch, sound, sight or other signals. Memes can be stored outside the individual and replayed later. 2) Gene changes usually take place over several generations. Memes can change several times in one generation. 3) Genes and memes are in symbiosis, but memes originate from genes.[70]

INSTINCTS

John Bonner provides a likely evolutionary path for culture emerging from single and multiple-choice instinctive behavior because "a pattern of behavior is, as far as natural selection is concerned, no different from any part of the anatomy of an animal. They are both ultimately gene-controlled, although . . . the gene control of behavior may be such that alternate choice behavior is possible. We are not yet talking about Lamarckian or cultural transmission of information; . . . the behavior . . . is Darwinian in the sense of involving gene changes through natural selection. Nevertheless, the flexibility afforded by

multiple choice behavior does permit an animal to find and exploit new habitats, new foods."[71, 72]

He explains that "these new niches will in turn produce new and different selective forces that will change all parts of the genetically controlled phenotype, including not only body structure but also the structure of the nervous system that will result in changes in behavior. Even though this flexibility is totally different from that found in cultural changes, it nevertheless is the kind of flexibility that has produced a foundation for culture. One can think of the appearance of culture as a new niche that arose from the experimentation with multiple choice behavior. And as a macroevolutionary step, it is undoubtedly the biggest of them all."[73]

Bruce Waller notes that studies of "feral white-footed mice that had learned to run through mazes for rewards" show that the "well-educated mice—quite familiar with the correct path to food—occasionally [took] the wrong route . . . ."[74] The significance is that variability is adaptive when conditions are constantly changing. Opportunities are missed or rapid response to changes reduced if an animal consistently sticks to routines in the wild. J. Lee Kavanau succinctly states that "the habit of deviating fairly frequently from stereotyped 'correct' responses, together with a high level of spontaneous activity, underlie the remarkable facility with which white-footed mice can

be taught to cope with complex contingencies."[75] Variety is the spice of life.

The reverse side of the coin is stubbornness in the face of change. Alternatives are always being sought, but older patterns once productive are revisited to avoid missing their benefits if they surge back. Bruce Waller points out that "behavior shaped on a variable interval schedule can be maintained with very limited positive reinforcement; and when the pattern is almost extinguished, one instance of positive reinforcement revives it to near full strength."[76]

LEARNING

Instinct extending to learning is part of an adaptive strategy of flexibility. "Learning implies plasticity, whereas instinct implies preparedness."[77] Today most scientists agree that the brain has structures that are environmentally programmed. "There are specialized mechanisms in the mind that are 'designed' by evolution to recognize faces, read emotions, be generous to one's children, fear snakes, be attracted to certain members of the opposite sex, infer mood, infer semantic meaning, acquire language, interpret social situations, perceive a suitable design of a tool for a certain job, calculate social obligations . . . ."[78] This view, that there is an instinct to learn, incorporates the duality of nature and nurture.

John Bonner enumerates the adaptive advantages of culture. First, there are many types of information that only culture can transmit. Secondly, interactions between individuals are enhanced. Creatures with larger brains increase their ability to recognize individuals. Richard Dawkins's idea that "animals use communications principally to manipulate one another rather than to transmit information"[79] firmly establishes the important benefits accruing to individuals from the explosion in signal complexity that led to language and culture.

Improved communications creates selective pressure for more complex brains. This occurs because information advantageous in reproductive competition can be directly transmitted from person to person. The need for further genetic complexity reduces with increasing brain size and its concomitant improved signal processing ability. With the birth of culture, behavior, once purely instinct tempered by experience, is enhanced with learned responses.[80]

There is no duality—man is shaped by the mutual influences of existing in a body and a culture. Genes, behaviors and ideas co-evolve. Man is not machine, but ecology.[81] For example, psychologists believe that children's personality is primarily affected by their peer ecologies—family birth order and school groups provide the bulk of the shaping.[82, 83] In other words, parents are ineffectual not because children don't listen, but be-

cause in the ecology in which children evolve, their effectiveness is tested by peers and siblings.

A hierarchy of data, information, knowledge and wisdom is created by successive processing, abstraction and symbol creation. Cultural mechanisms use signals, just like prices or feelings, that direct action and enhance fitness.

MEN AND WOMEN

The most important effect of man's early evolution was on sexuality. Donald Symons says that "there is a female human nature and a male human nature, and these natures are extraordinarily different . . .. Men and women differ in their sexual natures because throughout the immensely long hunting and gathering phase of human evolutionary history the sexual desires and dispositions that were adaptive for either sex were for the other tickets to evolutionary oblivion."[84]

Divergence between men and women increased competition and cooperation between and among the sexes and spurred rapid brain growth. Geoffrey Miller suggests "that the neocortex is not primarily or exclusively a device for toolmaking, bipedal walking, fire-using, warfare, hunting, gathering, or avoiding savanna predators. None of these postulated functions alone can explain its explosive development in our lineage and not in other closely related species . . .. The neocortex is largely a courtship device to attract and retain sexual mates: Its specific

evolutionary function is to stimulate and entertain other people, and to assess the stimulation attempts of others . . . ." [85]

He then creates a striking analogy. "Just as the peahen is satisfied with nothing less than a visually brilliant display of peacock plumage. I postulate that hominid males and females became satisfied with nothing less than psychologically brilliant, articulate, entertaining companions."[86] As Gregory Bateson points out—animals don't merely adapt to the environment, their existence changes the world they live in through mutual interaction and evolution.[87]

A sketch of human male-female selective signals—'The Human Mating Game'—can be made as follows. Women want wit, success, and height—males desire wit, youth, and figure. Poetry, songs, letters and emotionally stirring ripostes emerge. Men's desire for youthful mates—summarized in the face—creates multi-billion cosmetics demand by women. Fertility—embodied by a waist to hip ratio of 0.70 or less—equates to figure. Women condense success as status or wealth, and male fitness as height. Women seeking successful males and men wanting young women leads to older rich males with young pretty babes. Pornography emerges—males drool over nude nubile female images.[88] These basic mating signals create multiple cultural spin-offs and complications through the mutative expression of language and ideas. This complex selective environment leads to further

evolutionary emotional refinement—the brain becomes a collection of *cas* cooperating and competing for control.

THE BRAIN—JURYRIGGED CONTROL

The brain is a work in progress—it is a *cas* produced by evolution. The brain's capabilities and limitations arise from adaptation to environmental and cultural pressures. The brain is an amalgam of *cas* for internal and external processes—with *cas* for taste, smell, hearing, vision, emotion or motion all interacting with each other in a distributed fashion.

Each agent is composed of sub-agents with specific detectors-evaluators-effectors acting at their level of specificity—for vision, one level might be dots, lines, symmetry or circles; another might be eyes, ears, noses and hair; and, another might be faces and bodies. "Consciousness . . . is a kind of prioritizing meta-function that selects from the cacophony of internal signals ('voices') and creates a linear real-time narrative of 'what is going on' moment by moment."[89]

DYONISIAN AND APOLLONIAN

Man's brain is an ecology of primitive sense agents (taste, smell, touch, sound and vision) that are co-evolving with more modern coordinating and modeling agents (emotions and thought). The brain functions as a simulator of man's internal and external worlds—it does so implicitly and explicitly. For simplicity's sake only two overarching bipolar views—analysis and syn-

thesis, and thought and emotion—will be examined. In broad terms the brain is composed of two dualities: left brain (verbal—explicit) and right brain (spatial—implicit); and, cortex (thought—explicit) and amygdala (emotion—implicit). The discussion will show that words or images easily trigger emotions, but controlling emotions is difficult; and, that this arrangement was evolutionarily beneficial. The left and right brain dichotomy is described in Table 1.

When either mode exists exclusively then "the *hubris* of rationalism is matched by the *hubris* of irrationality . . .."[90] Arthur Koestler states that the millennial tension between "factual knowledge—*sophia*—of the external world . . . [and] *ousia*—essential Being" expresses itself as philosophy, focused on reason and concepts, and philousia, focused on intuition and symbols. "Obviously the two attitudes ought to complement each other like the principles of masculine logic and feminine intuition, the *yin* and *yang* in Taoist philosophy. And in the history of European thought they did indeed complement each other—either by simultaneously competing for supremacy or alternating in dominance. In every chapter of European history we can trace this creative polarity on various levels—the Dionysian and Appollonian principles . . ."[91]

Man's two primary methods of understanding the world, artistic and scientific, resonate deeply out of the structural

L —mode	**R** —mode
Verbal: Using words to name, describe, define.	Nonverbal: Awareness of things, but minimal connection with words
Analytic: Figuring things out step-by-step and part-by-part	Synthetic: Putting things together to form wholes
Symbolic: Using a symbol to *stand* for something.	Concrete: Relating to things as they are, at the present moment.
Abstract: Taking out a small bit of information to represent the whole thing.	Analogic: Seeing likenesses between things; understanding metaphoric relationships.
Temporal: Keeping track of time, sequencing one thing after another: Doing first things first, second things second, etc.	Nontemporal: Without a sense of time.
Rational: Drawing conclusions based on *reason* and *facts*.	Nonrational: Not requiring a basis of reason or facts; willingness to suspend judgement.
Digital: Using numbers as in counting.	Spatial: Seeing where things are in relation to other things, and how parts go together to form a whole.
Logical: Drawing conclusions based on logic; one thing following another in logical order—for example, a mathematical theorem or a well-stated argument.	Intuitive: Making leaps of insight, often based on incomplete patterns, hunches, feelings, or visual images.
Linear: Thinking in terms of linked ideas, one thought directly following another, often leading to a convergent conclusion.	Holistic: Seeing whole things all at once; perceiving the overall patterns and structures, often leading to divergent conclusions.

Table 1 —Left and Right Brain Modes.[92]

division of his mind. The difference is accentuated by human dimorphism. The two worldviews are phenomena emerging directly from the underlying human physical brain structure—balance between the two is often difficult.

Today's multimedia, interconnected world on a screen is directed at the right brain—the non-verbal, intuitive, asynchronous and spatial side—instead of traditional education based on literacy. When adults say their children don't think like them any more they're right—no language, no writing, only a flow of images, impressions, feelings and emotions. Richard Wagner would feel at home. TV and film media superficiality and sensationalism, violent interactive computer conditioning, instant connectivity, long-range weapons and illiteracy bode ill for judicious application of power in the 21st century.

But the tension between art and science is also an engine of inspiration, creativity and innovation. Cultural evolution in the West is in large part due to their interaction. The quandary lies in man's emotions.

RATIONAL—IRRATIONAL & EMOTIONAL

Beneath the mammalian brain of analysis and synthesis—rational and irrational—lies a reptilian emotional core. The evolution of implicit models, reflex to instinct to emotion, and their general control over man's explicit thought is an evolu-

tionary product. Successive *cas* aggregated onto previously tested *cas*—the older, more tested *cas* being dominant.

Why does a rational animal have emotions? First, because man is not generally a rational animal—he's a hodgepodge of implicit agents dealing with proximate causes with an illusion of coherency in that babble created through language and memory. Second, because man lives in only one body and has many conflicting goals to resolve in finite time. Reflexes were shaped by repeated millennial crisis into emotions that are still the arbiters of man's choices—implicit models that override the lately added explicit thought modules.[93] Embedded responses, reflexes and emotions, regulate most human behavior.

Daily Living

The sympathetic nervous system operates when man sees or thinks an emergency exists. It basically responds to the four F's—Fight, Flight, Fright and Fornication.[94] Joseph LeDoux explains that "modern evolutionary minded emotions theorists, like Ekman, argue that emotions deal with 'fundamental life tasks' . . .. [E]ach emotion prompts us in a direction that in the course of evolution has done better than other solutions to recurring circumstances . . .. [E]motions involve situations that have occurred over and over throughout our evolutionary history (escaping from danger, finding food and mates) and has caused us to appraise present events in terms of our ancestral past—that the

structure of the past imposes an interpretive landscape on the present. In a sense, coming up with a list of the special adaptive behaviors that are crucial to survival would essentially be a list of the basic emotions."[95]

Animals isolated on islands are the best proof that emotions are an evolutionary product. Without predators they lose fear—the most pervasive emotion dealing with survival. Most island animals have gone extinct. Those that didn't, like the Galápagos finch regained fear.[96]

Joseph LeDoux insists on the complexity of the emotional response system. "To the extent that emotional responses evolved, they evolved for different reasons, and it seems obvious to me that there must be different brain systems to take care of these different kinds of functions. Lumping all of these together under the unitary concept of emotional behavior provides us with a convenient way of organizing things—for distinguishing behaviors that we call emotional (for example, those involved with fighting, feeding, sex, and social bonding) from those that reflect cognitive functions (like reasoning, abstract thinking, problem solving, and concept formation). However, the use of a label, like "emotional behavior," should not necessarily lead us to assume that all of the labeled functions are mediated by one system of the brain. Seeing and hearing are both sensory functions, but each has its own neural machinery."[97]

Physical and cultural pressures have shaped this system of responses. Steven Pinker states that "each human emotion mobilizes the mind and body to meet one of the challenges of living and reproducing in the cognitive niche. Some challenges are posed by physical things, and the emotions that deal with them, like disgust, fear, and appreciation of natural beauty, work in straightforward ways. Others are posed by people. The problem in dealing with people is that people can deal back. The emotions that evolved in response to other people's emotions, like anger, gratitude, shame, and romantic love, are played on a complicated chessboard."[98]

Reciprocity and Emotions

Mutualism is a major part of human interactions. Reciprocal altruism develops when a big benefit is given at low cost with frequent role reversal. Individual recognition and memory of repayment or refusal determines future interactions. Humans have ingrained patterns to deal with reciprocal altruism—they are the greater part of man's morality.[99] Here's a list of how "Trivers reverse-engineered the moralistic emotions as strategies in the reciprocity game . . .. *Liking* is the emotion that initiates and maintains an altruistic partnership . . .. *Anger* protects a person whose niceness has left her vulnerable to being cheated . . .. *Gratitude* calibrates the desire to reciprocate according to the costs and benefits of the original act . . .. *Sympathy*, the

desire to help those in need, may be an emotion for earning gratitude . . .. *Guilt* can rack a cheater who is in danger of being found out . . .. *Shame*, the reaction to a transgression after it has been discovered, evokes a public display of contrition, no doubt for the same reason."[100]

Of course, just like mimicry in physical evolution, there is an incentive to cheat by faking emotions.[101] This results in generating trust and distrust, and makes humans avid consumers of gossip to expose cheaters. The nature of gossip forces man to avidly treasure reputation and take offense when it is maligned. This endless tug-of-war led Trivers "to propose that the expansion of the human brain was driven by a cognitive arms race, fueled by the emotions to regulate reciprocal altruism."[102]

Mutual Assured Destruction

Steven Pinker describes the story of Dr. Strangelove and mutual assured destruction and comes to the astonishing conclusion that "the unsettling paradoxes of nuclear strategy apply to *any* conflict between parties whose interests are partly competing and partly shared. Common sense says that victory goes to the side with the most intelligence, self-interest, coolness, options, power, and clear lines of communications. Common sense is wrong. Each of these assets can be a liability in contests of strategy (as opposed to contests of chance, skill, or strength)

where behavior is calculated by predicting what the other guy will do in response."[103]

Paradox is at the heart of bluffs and counter-bluffs, threats and counter-threats or promises and deceptions. "Terrorists, kidnapers, hijackers, and dictators of small countries have an interest in appearing mentally unbalanced. An absence of self-interest is also an advantage. Suicide bombers are almost impossible to stop. To defend yourself against threats, make it impossible for the threatener to make you an offer you can't refuse."[104] The schismogenesis—escalating 'arms' race—between Milosevich and Allbright is a current example of the handicaps of rationality, freedom and information in a threat-counter-threat scenario.

Steven Pinker says "people consumed by pride, love, or rage have lost control. They may be irrational. They may act against their interests. They may be deaf to appeals. (The man running amok calls to mind a doomsday machine that has been set off.) But though this be madness, there is method in it. Precisely these sacrifices of will and reason are effective tactics in the countless bargains, promises, and threats that make up our social relations."[105]

PASSION RULES

The implications are that "the intellect is designed to relinquish control to the passions so that they may serve as guar-

antors of its offers, promises, and threats against suspicions that they are lowballs, double-crosses, and bluffs. The apparent firewall between passion and reason is not an ineluctable part of the architecture of the brain: it has been programmed in deliberately, because only if the passions are in control can they be credible guarantors."[106]

Joseph LeDoux points out that the "amygdala [acts as a shunt, bypassing the cortical region, to generate an immediate emotional response to danger signals] has a greater influence on the cortex, than the cortex has on the amygdala. Throughout the mammals, pathways from the amygdala to the cortex overshadow the pathways from the cortex to the amygdala. Although thoughts can easily trigger emotions (by activating the amygdala), we are not very effective at willfully turning off emotions (by deactivating the amygdala)."[107]

MALE DOOMSDAY MACHINES

But man's violence does not need groups. Tales of individual male homicidal sprees or violent acts abound. Why duels? Blood feuds? Vendettas? The paradox of doomsday applies as Steven Pinker explains that "righteous anger, and the attendant thirst for redress or vengeance, is a credible deterrent if it uncontrollable and unresponsive to the deterrer's costs. Such compulsions, though useful in the long run, can drive people to fight far out of proportion to the stakes . . .. The lust for revenge

is a particularly terrifying emotion . . .. But in many societies an irresistible thirst for vengeance is one's only protection against deadly raids. Honor and vengeance are raised to godly virtues in societies that lie beyond the reach of law enforcement, such as remote horticulturalists and herders, the pioneers of the Wild West, street gangs, organized crime families, and entire nation-states when dealing with one another (in which case the emotion is called 'patriotism')."[108]

Male Reputation

Barbara Tuchman describes the enfilade of royalty at King Edward's funeral in 1910 as "in scarlet and blue and green and purple, three by three the sovereigns rode through the palace gates, with plumed helmets, gold braid, crimson sashes, and jeweled orders flashing in the sun."[109] Heraldry, hierarchy, gallantry and pecking orders all evolve from competition by males. A sound competitive strategy measures up rivals and avoids needless struggle; and, if fights are advantageous or necessary, stops before the bitter end—the strongest stands to get injured and the weakest stands to get killed.[110, 111] From that simple strategy emerges status.

Reputation is the leading homicide motivator in American cities. "Two young men argue over who gets to use the pool table in a bar. They shove each other around and trade insults and obscenities. The loser, humiliated before onlookers, storms off

and returns with a gun."[112] Steven Pinker explains that doctors and professors normally don't deal in violence because "'cultures of honor' spring up when a rapid response to a threat is essential because one's wealth can be carried away by others. They develop among herders, whose animals can be stolen, more often than among crop-owners, whose land stays put. And they develop among people whose wealth is in other liquid forms, like cash or drugs. But perhaps the biggest reason is that periodontists and professors are not male, poor and young."[113]

Men kill men twenty six times more frequently than women kill women. To be young and male is a huge risk factor for violence. "Young men commit crimes, drive too fast, ignore illnesses, and pick dangerous hobbies like drugs, extreme sports, and surfing on the roofs of tram cars and elevator. The combination of maleness, youth, penury, hopelessness, and anarchy makes young men indefinitely reckless in defending their reputation."[114]

Human-Bombs

Abject poverty, physical or cultural, breeds human-bombs by fomenting bottomless despair and malformed depravity.[115, 116] Where order breaks down, criminality thrives because it becomes adaptive—ownership and relationships are dismissed in favor of risk-taking and short-term benefits.[117]

Victor Alexandrov describes the interwar German mayhem as, "meanwhile, on the political scene, acts of violence had hardly ceased since the formation of the Workers and Soldiers' Councils in 1918. In 1921 Ehrhardt's assassins made their attempt on Scheidemann. In 1922 they killed Walther Rathenau. While the reactionaries were gathering strength, blood flowed in the Ruhr, there were revolts at Halle, Magdeburg, in Thuringia and at Hamburg . . . ."[118]

He says that "while this complex, desperate political struggle went on, the whole life of post-war Germany, its literature, theater, cinema, arts, painting and manners, reeked of sensationalism, hedonism, infatuation, eccentricity and immorality, with all their ramifications and accompanying manifestations. Alcoholism, drug-taking, sadism, masochism, homosexuality, every sort of perversion and aberration reached a peak, as did crime in general."[119]

That chaotic and violent environment bred a new form of kinetic war that soon erupted and almost destroyed Europe. Today a similar hotbed for radical innovation in the application of violence exists throughout most of the world, including Russia, where a large body of expertise in biological weapons exists.[120] Can bioblitzkrieg be far behind?

Running Amok

When a Malay man is badly spurned or publicly humiliated then goes on a killing spree, he has gone amok—in America he's said to have gone 'postal.' "The amok man is patently out of his mind, an automaton oblivious to his surroundings and unreachable by appeals or threats. But his rampage is preceded by lengthy brooding over failure, and is carefully planned as a means of deliverance from an unbearable situation. The amok state is chillingly cognitive. It is triggered not by a stimulus, not by a tumor, not by a random spurt of brain chemicals, but by an idea."[121]

A 1968 psychiatric interview of amoks haunts us today. "I am not an important or 'big man.' I posses only my personal sense of dignity. My life has been reduced to nothing by an intolerable insult. Therefore, I have nothing to lose except my life, which is nothing, so I trade my life for yours, as your life is favoured. The exchange is in my favour, so I shall not only kill you, but I shall kill many of you, and at the same time rehabilitate myself in the eyes of the group of which I am a member even though I might be killed in the process."[122]

Crazy Dogs

Lionel Tiger and Robin Fox examine male violence from another view because "in every society the dedicated killer crops up, and it takes no great imagination to see how useful he would be in times of trouble. A man who will give himself wholly over

to the killing life with dedication and even pleasure is just the man to send against the enemy on raids—which are essentially murder expeditions. In our own time he is the perfect commando, marine, green beret, or whatever. Among the Crow Indians, there was a society called the Crazy Dogs, or Those-born-to-die. These were young men dedicated to fight to the death and never move away from the enemy. To this end they would stake themselves into the ground with thongs tied through their back muscles and face the enemy."[123]

But the Crow tribe knew what it was unleashing. "They [Crazy Dogs] were reckless and lawless and were allowed all kinds of privilege and indulgence. On the night before a battle or raid, the Crazy Dogs would wreck the camp and rape the women—with impunity, because the next day some of them would die."[124]

Norse berserkers are akin to Crazy Dogs.[125] Tiger and Fox observe that "these killers are always with us, but whether they become our greatest heroes or our criminal lunatics depends on which end of the curve we decide to reward."[126]

Sturm Abteilungen and Schutz Staffeln

The Crow bred Crazy Dogs—the Nazis bred Rabid Dogs. Leonard Piekoff states that "for about a year the [concentration] camps were run by the thugs of the SA [Sturm Abteilungen or Storm Troopers], a group which included many freewheeling sadists, perverts, and psychopaths eager for an orgy of hatred and tor-

ture. The SS [Schutz Staffeln], which took over the camps after the Röhm purge and the fall of the SA, were a different breed. For the most part the new guards and administrators were ordinary men, at least at the beginning."[127]

He explains that "ideological indoctrination alone, it was found, could not create a corps of full-fledged Nazis; but the daily practice of concentration-camp-scale unreason could, and did."[128] In other words, concentration camps were training camps on top of all their other grisly purposes. Their function was not only to destroy prisoners and their individuality, but also to create out of young Nazis "monsters of obedience."[129]

A teratogenic uroboros—a cycle of monstrosity. "What the SS shaped was mass death without a murmur of protest; death accepted placidly by victims and killers alike; death carried out not as any kind of exception, not as an act of purposeful vengeance or hatred, but as casual, smiling, even homey routine, often against a background of colorful flower beds and to the accompaniment of lilting operetta music."[130]

Video Arcade Killers

On 20 April 1999, Hitler's birthday anniversary, two young males slaughtered their classmates at Columbine High School in Middleton, Colorado. Both were bright boys and had spent countless hours playing networked violent computer games.

Dave Grossman notes that "in Vietnam a systematic process of desensitization, conditioning, and training increased the individual firing rate from a baseline of 15 to 20 percent to an all-time high of up to 95 percent. Today a similar process of systematic desensitization, conditioning, and vicarious learning is unleashing an epidemic, a virus of violence in America."[131] Charlie Manson was right—Hollywood helped him do it.

But the mass murderers of yesterday were rookies. Today American kids are desensitized and conditioned relentlessly on violent first-person-shooter video games. The computer screen shows the barrel of the gun being toted and the victims graphically displayed being dismembered opposite the rain of bullets. There can be no doubt as to the training's efficacy—look at how routinely 11 year olds massacre classmates in America—incessant exposure to violence can create human killing machines. One cigarette or a hundred does not a cancer make—repeated exposure does.

Steven Pinker summarizes man's emotional paradoxes with—"exotic at first glance, upon scrutiny they turn out to be universal; quintessentially irrational, they are tightly interwoven with abstract thought and have a cold logic of their own."[132] There is evolutionary logic to war based on emotions. Emotions allowed reciprocity and war to emerge; then war, the greatest shaper of man, honed emotions to a sharp lethal edge.

THE WARRIORS'S COMPACT

> *Moses became angry with the commanders of the army, the officers of the thousands and the officers of hundreds . . .. Now, therefore, slay every male among the children, and slay also every woman who has known a man carnally; but spare every young woman who has not had carnal relations with a man.*[133]
>
> — Numbers 31

The name a tribe assigns itself delimits who is human—it defines murder.[134] "Killing one's antagonist is the ultimate conflict resolution technique, and our ancestors discovered it long before they were people."[135] Tags—tattoos, headbands, clothes, and jewelry—define the group. Killing those outside the group is not murder and when done by the tribe it is war. War is based on a simple idea: a group can get what an individual can't. "In fact, if the spoils are certain and divided up fairly, the level of danger doesn't matter . . . [if] none of them knows in advance who will be injured or killed."[136]

Steven Pinker notes that "in primitive warfare, mobilization was more complete, battles were more frequent, casualties higher, prisoners fewer, and weapons more damaging. War, is to put it mildly, a major selection pressure, and since it appears to have been a recurring event in our evolutionary history, it must have shaped parts of the human psyche."[137] Dudley Young asserts that "among primates, 80 percent of young males do not survive to maturity."[138] The anthropologist, Lawrence Keeley, echoes the thought that "primitive (and guerilla) warfare con-

sists of war stripped to its essentials; the murder of enemies; the theft or destruction of their sustenance, wealth, and essential resource; and the inducement in them of insecurity and terror."[139]

So if war is hell, why fight? Steven Pinker says that "in foraging societies, men go to war to get or keep women—not necessarily as a conscious goal of the warriors (though often it is exactly that), but as the ultimate payoff that allowed a willingness to fight to evolve . . .. The most common spoils of tribal warfare are women. Raiders kill the men, abduct the nubile women, gang-rape them, and allocate them as wives."[140]

David Buss notes that "gang warfare is common across America, especially in large cities such as Los Angeles, and death is a common outcome. Why do males join gangs in which they risk death?"[141] He quotes a gang member as saying, "The gang seemed to control the things I wanted. I was kind of a dork when I was in elementary school. I was really into my studies, and I didn't get involved in any stuff that the gang was doing. But then I began to see that they had the girls."[142]

Anecdotal evidence? David Buss goes on to cite Palmer and Tilley's work on Colorado gangs as well as Chagnon's studies of the Yanomamö Indians to show the increased access to females that coalition aggression imparts.[143] This adds another piece to the Human Mating Game: men look for face, figure and wit—women

look for height, status and wit; and, males compete for status—access to females. In other words, young inner-city males join gangs for tattoos and chicks.

David Buss describes a simple thought experiment. Ten warriors raid a neighboring village and abduct five nubile females. Their individual reproductive access increases by 0.50 (five females for ten warriors). If five warriors are killed, then the individual reproductive access of the survivors increases to 1.0 (five females for five warriors). Although in one case warriors die, the overall reproductive increase for the raiding party remains the same because one warrior's loss becomes another warrior's gain![144] J.M.G. Van der Dennen summarizes this as "warfare emerged as a high-risk/high-gain male-coalitional reproductive (or parental-investment) strategy . . .. Warring behavior is confined to typically highly-social and 'brainy' species, cognitively capable of establishing relatively long-term polyadic coalitions . . .."[145] War is a potent evolutionary force.

An evolutionary theory of human war—'The Risk Contract of War'—was proposed by John Tooby and Leda Cosmides in 1988.[146] Reciprocity is war's foundation and requires the following specifics "to participate in social exchange: individual recognition, memory for one's history of interaction, value communication, value modeling, and a shared grammar of social contracts that specifies representational structure and inferential proce-

dures."[147] In other words, human reciprocity entails value, identity, memory, grammar and modeling which allow the tribal *cas* to form, grow, and fission to create new groups since in preliterate times tribal sizes stayed at 50-100 persons. Under these conditions, war between proximate human tribes becomes reproductively advantageous.

David Buss describes the four conditions required for coalition aggression to be adaptive as follows: "1. *The average long-term gain in reproductive resources must be sufficiently large to outweigh the reproductive costs of engaging is warfare over evolutionary time . . .*.. 2. *Members of coalitions must believe that their group will emerge victorious . . .*.. 3. *The risk that each member takes and the importance of each member's contribution to the success must translate into a corresponding share of the benefits . . .*.. 3. *Men who go into battle must be cloaked in a 'veil of ignorance' about who will live or die.*"[148] So, under conditions of likely victory, if men fight together with equal likelihood of survival so that reproductive spoils are 'fairly' divided, then war is adaptively advantageous; or, the Risk Contract of War enhances average reproductive success, irregardless of individual risk, when reproductive spoils are certain.

David Buss gives some significant implications: "(1) men, but not women, will have evolved psychological mechanisms, designed for coalitional warfare; (2) sexual access to women will

be the primary benefit that men gain from joining male coalitions; (3) men should have evolved psychological mechanisms that lead them to panic and defect from coalitions when death appears to be an imminent result of remaining; (4) men should be more likely to go to war when their odds of success appear high, as when the number of men in their coalition greatly exceeds the number of men in the opposing coalition; (5) men should have evolved psychological mechanisms designed to enforce the risk contract—that is, to detect and punish cheaters, defectors, and traitors, and (6) men should have evolved psychological mechanisms designed to detect, prefer, and enlist men in the coalition who are willing and able to contribute to its success."[149]

Some further thoughts: (1) Helen of Troy was not just a literary embellishment—she was the face that launched a thousand ships; (2) polygamy exists when raiding brings in women and monogamy arises as a male contract to avoid inter-group conflict when wars are no longer fought over women;[150] (3) medals and awards are modern substitutes for women-as-spoils—men now compete and die for rank, insignia, ribbons and ideas; (4) cunning, reputation, loyalty, courage and passion are key attributes selected by coalition war. The characteristics that enhance performance in the Risk Contract of War increase male-female dimorphism and accelerate the workings of the Human Mating Game—the two selective mechanisms are interlocked;[151] (5) young single

males will display highly risk-prone behavior—young married males, even without High School diplomas, will make stable soldiers; (6) the Marine Corps's 13 week separate female and male recruit training has deep psychological roots which make it effective; (7) senior male officers with access to young females have the greatest likelihood of fraternization; (8) racial integration of males in fighting units is easy—female and male integration in fighting units can disrupt the Risk Contract. However, in non-combat situations male-female teams will be most effective;[152] (9) male-male aggression leads to murder, whereas male-female aggression leads to rape; (10) height has a strong selective pressure due to its impression on the enemy and as a sign of prowess within the group; (11) beards and baldness are irrevocable age markers—baldness indicates long term success and social maturity;[153] (12) wars with a likelihood of victory will always be initially popular; (13) uniforms identify members of the compact of war once the size of armies increase past village limits; (14) sports figures—uniformed performers of warrior spirit—will be highly paid even while their affinity for money and lack of team loyalty will chagrin fans and generate endless gossip. Raiding party band sizes will be analogous to team sizes. Some women will find the combination of money, status, height and 0.9 male waist-to-hip ratio irresistible;[154] (15) courage is common when men fight together—men will charge

undaunted across no-man's-land as a group—on the other hand, isolated, untrained men exposed to combat will suffer the greatest mental traumas;[155] (16) xenophobia and ethnocentrism are products of repeated human exposure to the success of the Risk Contract of War; (17) Berserkers, Amoks or Crazy Dogs exhibit aggression mechanisms developed to enhance fighting prowess—under the right circumstances most men are capable of these behaviors; (18) conditions that increase anxiety and tension among males will increase risk-prone behavior, especially if alcohol or drugs are used;[156] (19) war among ants was possible because at their scale chemical recognition allowed adequate identification and targeting—war became possible on mammalian scales when visual recognition became sufficiently sophisticated; (20) fighting units on the size scale of village raiding parties—ten to fifty men—should be the most effective; (21) when navigating territory, males should rely on abstraction while women should rely on landmarks—men should be better at geometry and women better at remembering object locations;[157] (22) men should prize facts, philosophy, above emotions—women should value feelings, philousia, over things;[158] and, (23) precision, effects-based war that doesn't account for emotions cannot be decisive because the underlying clash of human wills remains unresolved.[159]

A final suggestion is that recruiting advertisements based on status and family would resonate with males—a young sergeant

returning home is smartly saluted by a private as the sergeant rushes by into the awaiting arms of his beloved—tattoos and chicks are a strong subliminal message. Military services should broadcast loud and clear that their ranks are over 70% married—that being in the service is a good reproductive strategy. In any case, The Risk Contract of War provides an evolutionary paradigm for understanding man's capacity for group aggression and the development of emotional and cultural mechanisms to enhance survival under the conditions of war it facilitates. Keeping it in mind helps show why males are so sensitive to their status and reputation.

OVERWEENING PRIDE

Once the mechanisms for group violence are imbedded in individuals, fights erupt easily—even without spoils in sight. Hatred is an easy emotion to arouse. Psychological experiments that divide people into two groups based on an announced trivial reason—such as liking a painting or not, when it was actually done at random—have the bizarre results that "each group instantly dislike and think worse of the people in the other group, and act to withhold rewards from them even if doing so is costly to their own group. This instant ethnocentrism can be evoked even if the experimenter drops the charade with the . . . paintings and divides people into groups by flipping a coin before their eyes! The behavioral consequences are by no means mi-

nor." [160, 161] "Sometimes the truth is adaptive, but sometimes it is not. Conflict of interest are inherent to the human condition . . . and we are apt to want *our version* of the truth rather than the truth itself."[162]

BENEFECTANCE

Neuroscientists and psychologists have long studied man's ability for self-delusion. Steven Pinker states it well when he says "our confabulations, not coincidentally, present us in the best light . . .. We delude ourselves about how benevolent and effective we are, a combination that social psychologists call benefectance. When subjects play games that are rigged by the experimenter, they attribute their successes to their own skill and their failures to the luck of the draw."[163]

And, on a more sinister note he observes that "when they are fooled in a fake experiment into thinking they have delivered shocks to another subject, they derogate the victim, implying that he deserved the punishment. Everyone has heard of 'reducing cognitive dissonance,' in which people invent a new opinion to resolve a contradiction in their minds . . . [but in reality] people doctor their beliefs only to eliminate a contradiction with the proposition 'I am nice and in control' . . .. [S]elf-deception is the cruelest motive of all, for it makes us feel right when we are wrong and emboldens us to fight when we ought to surrender."[164] Can Hubris be far behind?

GAS WITH A MATCH

The ease with which xenophobia ignites and man's infinite capacity for self-deception leads to bloodbaths. Peter Calbert notes that "since 1945 the most chilling example of the ultimate consequences of believing in both the unrestrained power of government and in the need to eradicate the rational from a culture has been the killing fields of Cambodia in Year Zero, when independent teams of Pol Pot's Khmer Rouge peasant revolutionaries deliberately smashed every vestige of advanced civilization, depopulated the towns and killed anyone who looked like an intellectual . . . ."[165]

Emotional flames fueled by ethnic hatreds led to Franz Ferdinand's assassination on his visit to the Serbs on "St. Vitus's Day, the anniversary of the battle of Kossovo in 1389, the defeat of the Serbs by the Turks which meant five hundred years of enslavement. That defeat had been wiped out in the Balkan War by the recapture of Kossovo, and it was not tactful to remind the Serbs that some of their people were still enslaved by a foreign power."[166]

But ethnicity is not destiny. Institutions can incorporate different groups into society. Cities traditionally were absorptive centers.[167] When nobles granted economic power to guilds in the middle ages "cities became poles of attraction, places of refuge, nodes of exchange with the countryside. Migration to

cities improved the income and status not only of the migrants but also of those left behind. (Not their health. The cities were dirty, crowded, and lent themselves to easy contagion, so that it was only in-migration that sustained their numbers and enabled them to grow.) Self-emancipation in Western Europe was directly linked to the rash of franchised villages and urban communes, and to the density and proximity of these gateways. Where cities and towns were few and unfree, as in Eastern Europe, serfdom persisted and worsened."[168]

The biblical imperative to breed was borne by peasants who spoke local dialects. They supplied the manpower cities required. The rich developed moral checks while the poor relied on high birth rates, insurance for an uncertain future, and fell prey to Malthusian checks.[169] Austro-Hungary succeeded at integrating a Slav and Magyar peasantry into the Hapsburg cultural system until cholera destroyed her German regulatory and educational hierarchy in the 1850's.[170] The Hapsburg's remained in power a while longer by creating the dual-monarchy with Hungary, but were finally toppled by inept handling of a restless Slav population.

MAN—AVATAR OF CHANGE

Man has become a self-modifying agent—internally and externally. Culture and technology are now strong factors affecting human behavior. The future won't be woven out of natural fi-

bers—man will use synthetic fibers to knit a cloth with properties only dimly perceived. If that cloth is to cover man's nakedness, then culture, the loom of societies, must become a cohesive force.[171, 172] And, to wisely guide the emergence and evolution of political systems from culture, the basis of man's nature must be understood.[173]

Taking comfort that hydroponics, aquaculture, lasers, global communications, robotics and all other present and future technologies will pacify, clothe, house, educate and feed the world has not worked. Utopia has always been just around the corner and the majority of the world always struggles with subsistence and chaos. An emphasis on technology is a blinder to the importance of culture and the human element.

Economic conditions can set the stage for political and social changes. "The collapse of speculative bubbles in various stock markets, coupled with incompetent monetary and tariff policies, triggered a worldwide depression that hit hardest in Germany. Economic disaster bred political chaos, which allowed the Nazis to do well in one semi-free national election and to seize dictatorial power soon afterwards. Economic problems were alleviated by restarting the German industrial sector with large military orders for new equipment and an ambitious program of civilian projects including the Autobahn system. Unemployment fell from 30.1% in 1932 . . . to 8.3% in 1936 . . ."[174]

David Fischer points out that crime, out of wedlock pregnancy and alcoholism rates correlate over centuries with economic crisis[175]—but, they do not determine the political choices that societies make. Those that enshrine the irrational collective in their political systems end up with Gulags and Gestapos.[176]

Robert Kaplan points out that "West Africa is becoming the symbol of worldwide demographic, environmental, and societal stress, in which criminal anarchy emerges as the real 'strategic' danger. Disease, overpopulation, unprovoked crime, scarcity of resources, refugee migrations, the increasing erosion of nation-states and international borders, and the empowerment of private armies, security firms, and international drug cartels are now most tellingly demonstrated through a West African prism."[177] If 95% of the world transforms into Kaplan's dark vision, can the US survive? Where are these conditions being recreated? Amoks are difficult to stop once triggered, but the teratogenic bogs where monsters spawn can be drained.

A Serb tells Rebecca West in 1939—"'We will stop at Grachanitsa, the church I told you of on the edge of Kossovo Plain, but I do not think you will understand it, because it is very personal to us Serbs, and that is something you foreigners can never grasp. It is too difficult for you, we are too rough and too deep for your smoothness and your shallowness."[178] And

perhaps we have become shallow in a deep sense by mindlessly enshrining technology since values and culture are the strategic battleground.

MACHINIC PHYLUM—HUMAN CATALYSTS

Human self-modification is here due to the synergy of cryogenics, nanotechnology, artificial intelligence, cloning, bioengineering, microsurgical techniques, synthetic pharmaceuticals and genetic engineering. A man missing a hand has one transplanted from a corpse; a man whose heart arteries are clogged has a gene modified and grows a new mass of life supporting tissue; or, a sterile woman carries an artificially inseminated donor egg to full term.

The confluence of intelligent agents, nanotechnology, increasing computational power, and robotics point to the creation of a machinic phylum.[179, 180] Adequate cultural adjustments are needed to incorporate man's interface with this emerging intelligence without emotion. Malleable minds ingesting an endless stream of trash and invective, mindlessly and repeatedly killing opponents on a screen will eventually unleash the dark demons societies have been crafted to contain.

SUMMARY

Life is *cas* thriving in the sun's energy stream. Sparked by energy, life's expression and freedom of motion is delineated by information—for humans, genes, language and culture.

All creatures struggle, through competition and cooperation, to reproduce amidst disease and predators in a changing environment. The enemy within and the enemy without conspire against all life. When existence is threatened, the outcome is battle, disease, migration, adaptation or extinction.

At first the interacting strands of water, energy, food, demographics, climate and disease shaped man. Man subjected to stresses, like social insects, flocked into groups that enhanced survival. From that environment of aggregation reciprocity ensued and then the two primary human selective sieves—The Human Mating Game and the Risk Contract of War—resulted in rapid modification of man's emotions and mind. A counterpoint of alternating wars and pandemics influenced man's evolutionary trajectory while man's expanding mental faculties fueled cultural and demographic growth. Increased population sizes, culture and its offshoot, technology, became critical amplifiers of man's abilities and created powerful feedback conduits that increased change of man and environment. Innovation brought forth microscopes and drugs to fight diseases; and, telescopes and projectiles to fight men.

In the late 20th century man gained the upper hand against micro-parasites and mass war. And beyond starting to control his old enemies, man is modifying himself and creating a new machinic phylum of intelligent machines. Man stands poised, a pre-

carious victor, over his internal and external enemies. Yet he teeters at the edge of an infinite abyss of change and mutation while caught in the quagmires of the past. Can he survive the powerful effects of his own creations—ecological toxicity, cultural dissolution and biological permutation—while fighting atavistic demons—hubris and warriors?

Stability cannot exist in a world of flux—only perpetual change. *Cas* survive at the price of continual adaptation. War is a problem solving technique in a never-ending process of restructuring. Man's cultural flexibility may yet create new processes for renewal to occur in peace, but that perfect world will wait at least a century or two because man's evolved nature lags the possibilities. Until that time comes, the classic Horsemen of the Apocalypse—famine, plague, war & death—will reign due to man's schizophrenic nature.

Steven Pinker assesses that "our thoroughgoing, perplexity about the enigmas of consciousness, self, will, and knowledge may come from a mismatch between the very nature of these problems and the computational apparatus that natural selection has fitted us with . . .. Our bafflement at the mysteries of the ages may have been the price we paid for a combinatorial mind that opened up a world of words and sentences, of theories and equations, of poems and melodies, of jokes and stories, the very things that make a mind worth having."[181]

He also points out that "on the larger stage, history has seen terrible blights disappear permanently, sometimes only after years of bloodshed, sometimes as if in a puff of smoke. Slavery, harem-holding despots, colonial conquest, blood feuds, women as property, institutionalized racism and anti-Semitism, child labor, apartheid, fascism, Stalinism, Leninism, and war have vanished from expanses of the world that had suffered them for decades, centuries, or millennia. The homicide rates in the most vicious American urban jungles are twenty times lower than in many foraging societies. Modern Britons are twenty times less likely to be murdered than their medieval ancestors."

And language and culture have also helped dampen many of man's worst faults. Pinker goes on to say that "literacy, knowledge, and the exchange of information have undermined some kinds of exploitation . . .. Information can be framed in a way that makes exploiters look like hypocrites and fools. One of our baser instincts—claiming authority on a pretext of beneficence and competence—can be cunningly turned on the others. When everyone sees graphic representations of suffering, it is no longer possible to claim that no harm is being done."

And finally, he observes that "people throughout history have invented ingenious technologies [social mechanisms] that turn one part of the mind against another and eke increments of civility from a human nature that was not selected for niceness:

rhetoric, exposés, mediation, face-saving measures, contracts, deterrence . . . courts, enforceable laws, monogamy . . .. Utopian theoreticians ought to be humble in the face of this practical wisdom. It is likely to remain more effective that 'cultural' proposals to make over childrearing, language and the media, and 'biological' proposals to scan the brains and genes of gang members for aggression markers and to hand out antiviolence pills in the ghettos."[182]

And so, this short tour of the evolution of man's haughty and murderous nature ends on a note of ancient hope—of reaching the golden mean—where a balance of emotion and thought; art and science; man and society; and, justice, freedom and equality can live in the hominid soul. Before dying while mountain climbing, Heinz Pagels left us with the thoughts that "reason dreams of an empire of knowledge, a mansion of the mind. Yet sometimes we end up living in a hovel by its side. Reason has shown us our capacity for power, both to create and to destroy. Yet how we use that power rests on our deeper capacities which lie beyond the reach of reason, beyond our traditions and culture, stretching far back into the depths of the evolutionary process that created our species, a process that ultimately asserts the power of life over death. And, ironically, even death, as part of the process of life, asserts that power. That is how we have come

into being and now find ourselves committed to the unrelenting moral struggle of ordinary human existence."[183]

The 21st century might be "the threshold of a great adventure of the human spirit—a new synthesis of knowledge, a potential integration of art and science, a deeper grasp of human psychology, a deepening of the symbolic representation of our existence and feelings as given in religion and culture, the formation of an international order based on cooperation and nonviolent competition. It seems not too much to hope for these things. The future as always, belongs to the dreamers."[184]

Yes, dream and hope, but keep your gunpowder dry.

Word count= 19,508.

ENDNOTES

[1] Will and Ariel Durant, Our Oriental Heritage, 459.

[2] Allan Nevins, The Gateway to History (Garden City, NY: Anchor Books, 1962), 247.

[3] Williamson Murray, The Emerging Strategic Environment in the Next Century: An Historian's Thoughts—War, Power, Economy, Demography, Revolution, Upheaval, Change, Contingency, Unpredictability, Discontinuity, Military History Institute lecture, 20 January 1999, Carlisle, PA. Professor Murray discussed hubris and tyche—overweening pride and fortuitous serendipity—as great shapers of events.

[4] Darwinian evolution works by shaping and selecting individuals. War, a group activity, has played prominently in man's evolution but is only shared with ants. Why didn't wolf-packs, or for that matter lion-prides or elephant-herds create war like man-bands did? Is it because their search strategies rely too heavily on scent, a limited signaling and detection device, vice man's reliance on vision? Is it man's omniverous eating habits? Or fortuitous happenstance that allowed man to arrive at effective groups thereby achieving lock-in and lock-out of other species like the QWERTY keyboard did with the DVORAK keyboard? Is it man's forced adaptations to jungle, savannah and ocean environments as Elaine Morgan contends? Or is it a matter of numbers, which ants had, that allows war to emerge?

[5] Matt Ridley, The Red Queen, Sex and the Evolution of Human Nature (New York: Penguin Books, 1993), 71.

Leaving aside for the moment such things as fleas and mosquitoes, let us concentrate on viruses, bacteria, and fungi, the causes of most diseases. They specialize in breaking into cells—either to eat them, as fungi and bacteria do, or, like viruses, to subvert their genetic machinery for the purpose of making new viruses. Either way, they must get into cells. To do that they employ protein molecules that fit into other molecules on cell surfaces; in the jargon, they "bind." The arms races between parasites and their hosts are all about these binding proteins. Parasites invent new keys; hosts change the locks. There is an obvious group-selectionist argument here for sex: At any one time a sexual species will have lots of different locks; members of an asexual one will all have the same locks. So a parasite with the right key will quickly exterminate the asexual species but not the sexual one. Hence, the well-known fact: By turning our fields over to monocultures of in-

creasingly inbred strains of wheat and maize, we are inviting the very epidemics of disease that can only be fought by the pesticides we are forced to use in ever larger quantities.

[6] Ronald F. Fox, Energy and the Evolution of Life (New York: W.H. Freeman and Company, 1988), 154.

[7] Jonathan Wiener, The Beak of the Finch (New York: Vintage Books, 1995), 255.

[8] Eva Jablonka, Marion J. Lamb, and Eytan Avital, "Lamarckian' Mechanisms in Darwinian Evolution," Trends in Ecology & Evolution (May, 1998, 13): 206-210.

When Charles Darwin first developed his ideas of evolution, Darwin and Jean-Baptiste de Lamarck had clear-cut differences in their evolutionary theories. History declared that Lamarck got it wrong. Darwin proposed evolutionary change through selective pressures on genes, while Lamarck saw evolutionary change through acquired characteristics that are inherited to produce evolutionary change. Today, evolutionary biologists, reconsidering some of Lamarck's ideas in terms of Darwinian evolution, concede genetic systems may not be the only source of heritable variation. "Lamarckian," or instructive mechanisms, may work to produce heritable changes dependent on the environment. The addition of Larmarckian mechanisms does not replace classic Darwinian evolution; rather, it expands the theory to recognize instructive inheritance evolving through natural selection.

[9] Gregory Bateson, Steps to an Ecology of Mind: A Revolutionary Approach to Man's Understanding of Himself (New York: Ballantine Books, 1972). Bateson's schismogenesis is an arms race. He differentiates between different feedback mechanisms and uses the beautiful image of early horses being shaped by grass and in turn shaping the environment for grass.

[10] Wiener, 252-255. The elimination of the sodium channel—once thought to be essential to life—in Heliothis virescens, the cotton moth, due to human use of pyrethroids shows how organisms will dodge, evolve, assimilate, or reduce internal targets to external agents to continue living.

[11] Laurie Garrett, The Coming Plague (New York: Penguin Books, 1994), 603.

[12] Syndics of Cambridge University Press, The Holy Bible (Cambridge, UK: Cambridge University Press), 4-5. Genesis 4:2 to 4:12. And he said, What hast thou done? The voice of thy brother's blood crieth unto me from the ground. And now art thou cursed from the earth, which hath opened her mouth to receive thy brother's blood from thy hand; When thou tillest the ground, it shall not henceforth yield unto thee her strength; a fugitive and a vagabond shalt thou be in the earth.

[13] This myth correlates well with the historic incapacity of cities to maintain population growth without inflows from the countryside—they were human sinks.

[14] The environment includes culture, economics, geography, disease, history, climate, politics, resources and demographics.

[15] West, 9.

[16] Heinz R. Pagels, The Dreams of Reason: The Computer and the Rise of the Sciences of Complexity (New York: Simon and Schuster, 1988), 53.

[17] Carl Von Clausewitz, On War trans. Michael Howard and Peter Paret (Princeton, NJ: Princeton University Press, 1976), 89.

An army in garrison does not experience the stresses and strains of war and therefore can drift into bureaucratic lassitude. Additionally armies at home are constrained with discipline in order to contain their potentially destructive impact on domestic politics and life. The elemental force of war is described by Clausewitz as:

"War is more than a true chameleon that slightly adapts its characteristics to the given case. As a total phenomenon its dominant tendencies always make war a remarkable trinity—composed of primordial violence, hatred, and enmity, which are to be regarded as a blind natural force; of the play of chance and probability within which the creative spirit is free to roam; and of its element of subordination, as an instrument of policy, which makes it subject to reason alone . . .. These three tendencies are like three different codes of law, deep-rooted in their subject and yet variable in their relationship to one another. A theory that ignores any one of them or seeks to fix an arbitrary relationship between them would conflict with reality . . ."

[18] Ibid., 119.

Everything in war is very simple, but the simplest thing is difficult. The difficulties accumulate and end by producing a kind of friction that is inconceivable unless one has experienced war . . .. A battalion is made up of individuals, the least important of whom may chance to delay things or somehow make them go wrong. The dangers inseparable from war and the physical exertions war demands can aggravate the problem to such an extent that they must be ranked among its principal causes.

[19] S.L.A. Marshall, Men Under Fire (Gloucester, MA: Peter Smith, 1978), 179.

[20] Ibid., 161.

All values are interpreted in terms of the battlefield itself. Yet above and beyond any symbol—whether it be the individual life or a pillbox commanding a wadi in Sahara—are all of the ideas and ideals which press upon men, causing them to accept a discipline and to hold to the line even though death may be at hand.

If any man doubts that these values have a place in hardening the resolve of an army, let him answer the question: What happens when an army loses faith in its cause?

[21] Ibid.

Men who have been in battle know from first-hand experience that when the chips are down, a man fights to help the man next to him, just as a company fights to keep pace with its flanks. Things have to be that simple.

[22] Patrick Henry Winston and Berthold Klaus Paul Horn, LISP (Reading, MA: Addison-Wesley Publishing, 1984), 63-67. LISP is a LISt Processing language that treats lists as either data or functions based on context, for example: (+ 1 2) evaluates to 3, whereas '(+ 1 2) evaluates to (+ 1 2). LISP easily incorporates recursion and iteration as described by Winston and Horn:

So far, you have seen nesting of procedures, where one calls upon others to do part of the work, like people do when working in a mature bureaucracy. Here, however, the procedure calls upon *itself*, either directly or though an intermediary, to tackle a subtask. This is called *recursion*.

The second purpose is to see how to make a procedure do something over and over until an explicit stopping criterion is satisfied. This is called *iteration*.

A *control structure* is a general scheme by which a procedure can go about getting things done. Recursion and iteration are examples of control structures . . ..

[In recursive calls a function] either considers a situation basic, or hands a simplified problem to a copy of itself. [The function] does not need to remember anything while the copy is at work . . .. Conceptually, the copy does not have to return to the original procedure. Instead, the copy could return directly to the caller of the original procedure.

[23] John Holland, Hidden Order (Reading, MA: Helix Books, 1995), 45. The seven *cas* basics and functioning are all from Holland.

[24] Gary Cziko, Without Miracles (Cambridge, MA: The MIT Press, 1995), 232.

[25] Joseph Levine and David Suzuki, The Secret of Life (Boston: WGBH Educational Foundation, 1993), 226.

The three components of behavior are produced by classes of specialized cells: sensory receptors, neurons, and muscles. These "information receivers," "decision makers," and "action enablers" are wired into networks whose complexity makes computers look like tin-can telephones. Where does the "wiring diagram" for those networks come from? You've seen in earlier chapters that genes guide the formation of every tissue in the body. So genes *must* influence the construction of the eyes, ears, brain, nerves, and muscles, hence the way they work. No amount of training can enable a chimpanzee to communicate with the skill of a ten-year-old human child; this disparity in intelligence exists thanks to differences in brain structure and function whose origins trace back to differences between human and chimpanzee genomes.

Beyond that general observation, many specific studies link heredity and animal behavior. Researchers have agreed for years that certain "instinctive behaviors" must be largely preprogrammed by genetic instructions because many animals perform such behaviors without prior experience.

[26] Ilya Prigogine. From Being to Becoming: Time and Complexity in the Physical Sciences. New York: W.H. Freeman, 1980. Describes autopoeisis as systems that maintain their structure by existing in an energy gradient. They are dissipative structures because they absorb energy and dissipate entropy from and to the environment. Autocatalysis and autopoeisis are recursive systems that underlie the basis of life.

[27] Holland, Hidden Order, 4 and 38.

[28] Ibid., 46.

[29] Ibid., 44.

[30] Ibid., 53.

[31] Ibid., 55.

[32] Ibid., 56.

[33] Ibid.

[34] Cheating is a recurring natural motif. Cryptographic keys and locks become important to prevent vital resource exploitation by foreign organisms, e.g. viruses, bacteria, etc. When organisms are unable to authenticate who should be in and who should be out they perish. Sex functions to keep the variability of complex organisms one step ahead of their parasites as well as to generate flexibility and adaptability in changing environments. Cheater detectors and identity are crucial for mutualism.

[35] Ibid., 58.

[36] Ibid. Also see Pinker, 393-396. Pinker discusses 'myopic discounting' or the acceptance of a short-term small reward over a long-term large reward. He points out that internal tension increases as the time horizon for the short-term reward diminishes while the long-term reward remains unfulfilled, until the individual caves-in to the temptation at hand, thereby discounting the long-term goal. The fat man decides to put off dessert to lose pounds, but can't resist the cheesecake offered a few minutes after dinner.

Evolving in an uncertain environment favored taking rewards now and was probably reinforced by the manner in which general rules evolve into more specific rules.

What was it Freud said about postponement for later gratification?

[37] Ibid., 43-61.

[38] Tom Czerwinski, Coping with the Bounds: Speculations on Nonlinearity in Military Affairs. (Washington, D.C.: National Defense University, 1998), 7-27. Czerwinski offers an excellent summary of John Holland's *cas* approach as well as other reading.

[39] Gerardo R. Ungson and John D. Trudel, Engines of Prosperity: Templates for the Information Age (London: Imperial College Press, 1998), xi.

[40] Ian Stewart, Life's Other Secret (New York: John Wiley & Sons, 1996), 207.

[41] Fox, 155.

[42] Pinker, 427.

[43] Kevin Kelly, Out of Control (Reading, MA: Addison-Wesley Publishing, 1994), 306.

Ants have distributed parallel systems all figured out. Ants are the history of social organization and the future of computers. A colony may contain a million workers, and hundreds of queens, and the entire mass of them can build a city while only dimly aware of one another. Ants can swarm over a field and find the choicest food in it as if the swarm were a large compound eye. They weave vegetation together in coordinated parallel rows, and collectively keep their nest at a steady temperature, although not a single ant has ever lived who knows how to regulate temperature.

An army of ants too dumb to measure a very rugged landscape and too blind to see far can rapidly find the shortest route across a very rugged landscape. This calculation perfectly mirrors the evolutionary search: dumb, blind, simultaneous agents trying to optimize a path on a computationally rugged landscape. Ants *are* a parallel processing machine . . ..

The Milan group . . . constructed formulas based on ant logic. Their virtual ants ("vants") were dumb processors in a giant community operating in parallel. Each vant had a meager memory, and could communicate locally. Yet the rewards of doing well were shared by others in a kind of distributed computation . . ..

Ant algorithms are a type of Lamarckian search. When one ant stumbles upon a short route, that information is indirectly broadcast to the other vants by the trail's pheronome strength. In this way learning in one ant's lifetime is indirectly incorporated into the whole colony's inheritance or information. Individual ants effectively broadcast what they have learned into their hive. Broadcasting, like cultural teaching, is part of Lamarckian search.

[44] John Holland, Emergence: From Chaos to Order, 121-122. (Emphasis in original)

[45] Tom Czerwinski, Coping with the Bounds (Washington, D.C.: National Defense University, 1998), 31-36. Czerwinski emphasizes the exponential growth of agent interactions with linear increases in agents so that "10 agents can generate up to 45 interactions; 100 up to 4,950; 1000 up to 499,500 . . ." and thereby rapidly create the non-linearity and stability exhibited by CAS. That's why command of a platoon is not the same as command of an army.

[46] Holland, Hidden Order, 23.

[47] Ibid., 25.

[48] Ibid., 27.

[49] Ibid., 29.

[50] Ibid., 14-15.

[51] Ibid., 34-37. John Holland uses the term 'building blocks' as the process of assembling from sub-units.

[52] Ibid., 69-70.

[53] Fox, 144-146.

[54] Joseph LeDoux, The Emotional Brain (New York: Simon & Schuster, 1996), 126.

[55] Holland, Hidden Order, 89.

[56] Ibid., 33.

[57] Robert U. Ayres, Information, Entropy, and Progress, A New Evolutionary Paradigm (New York: American Institute of Physics Press, 1994), 93.

[58] Lamarckian evolution.

[59] Ibid., 110-111. (emphasis in original)

[60] Levine, 233.

[G]ene environment interactions are integral to the growth and function of the nervous system, and hence to the emergence of behavior. Consider first the 100 billion neurons in the hu-

man brain, each of which typically passes information to as many as 1,000 of its fellows, and receives input from as many as 10,000 more. There couldn't possibly be enough information in the human genome to direct the wiring of each and every connection between those cells. Instead, it seems that genes map out general "wiring diagrams" for the nervous system by producing trains of chemical markers. Typically, the growing tip of a young neuron "sniffs" its way along a trail of those marker molecules like a bloodhound searching for prey. Ultimately, it locates its genetically programmed attachment point, connects with other neurons in the vicinity, and begins to communicate with them.

But from that point on, the messages the neuron receives and passes along depend on activity in the developing brain, which in turn depends on the experiences of the animal. And critically, differences in those experiences—which result in different patterns of brain activity—determine which neurons remain alive and how their interconnections are finalized. This phenomenon was demonstrated through experiments with cats, in which the final wiring between eye and brain is not completed until after birth. It turns out that if kittens are raised in artificial environments containing nothing but horizontal lines, their brains fail to develop and maintain the neural connections that enable them to see vertical objects. Such animals often bump into chair legs because their nervous systems have been permanently altered, not by genetic anomalies, but by unusual environmental conditions.

This powerful effect is only part of environment's potential influence on brain and behavior. In many animals, neural circuitry retains some flexibility throughout life, making it possible for experience to modify existing patterns of behavior through learning—a process that often involves changes in behavior once labeled as genetically hard wired.

[61] Levine, 231. Yet another factor complicates efforts to link genes and behaviors: interactions between genes and environment. Although genetic instructions *shape* certain traits, genes don't necessarily *determine* those traits irrevocably. Why? Because genetic instructions and environmental influences interact constantly during growth and development. Those interactions can profoundly affect the final characteristics of traits ranging from physical features to fine-tuning of the nervous system. Several simple examples make this point in different ways.

Most fishes have two eyes, a trait "controlled" by genes that govern development of the head and the nervous system and

differentiation of the left and right sides of the body. But in the early 1900's, one experimenter raised fish embryos in seawater containing a high concentration of magnesium ions, with unexpected results. Some embryos, which carried the same genes for eye development as normal fishes, developed a single, cyclopean eye instead of the normal pair. What happened? The change in magnesium concentration didn't cause any mutations in DNA. Instead, in a manner still not understood, a change in environmental conditions caused a dramatic chance in *gene expression* during development. Genes which "determine"—irrevocably, one would have thought—that developing larvae grow two eyes, no longer acted the same way to produce the same trait.

An equally dramatic effect is found in certain human conditions. The defective genes that cause PKU, for example, once invariably led to severe mental retardation. Then researchers identified the problem as an inability to metabolize phenylalanine. Armed with that knowledge, physicians can now identify phenylketonurics early in infancy and place them on phenylalanine-free diets. This simple dietary change dramatically alters their genetic "destiny" by enabling them to mature into perfectly normal, healthy adults.

Notice what has happened here. These individuals carry precisely the same genetic flaws that would once have doomed them to retardation, but as long as they steer clear of phenylalanine, they have a much different prognosis. Now, PKU is a highly heritable condition; homozygotes for the defective gene cannot metabolize that amino acid. But the end results of that inability can vary enormously, depending on environmental conditions.

[62] Fox, 3-5.

[63] Elaine Morgan, The Scars of Evolution (Oxford: Oxford University Press, 1990). A fascinating discussion of the possible influence of the ocean on man's physical characteristics.

[64] Levine, 228. Over time, sociobiologists have discussed, in largely theoretical terms, the notion of genes in humans and other animals that influence aggression, dominance, altruism, selfishness, and other similarly complex behaviors.

But while it is possible to argue that genes influence behavior in a general sense, it is quite another matter to show that a *specific* gene—or pair of genes, or even a score of genes—actually control *specific* details of an animal's responses to its environment.

[65] Edmund Burke, Reflections on the Revolution in France (1790); quoted in William Ebenstein, Modern Political Thought: The Great Issues (New York: Holt, Rinehart and Winston, 1960), 302-319. The creation of political *cas* by humans has been fraught with peril and disasters. Edmund Burke's writing anticipates Darwin and Wallace as he describes British political structures as evolutionary products which function as *cas* acting without computation—"nature, which is wisdom without reflection." His writing clearly shows a deep understanding of man's emotional basis.

He describes the concept of complex flows interacting nonlinearly in aggregates as "that which in the first instance is prejudicial may be excellent in its remoter operation; and its excellence may arise even from the ill effects it produces in the beginning. The reverse also happens . . .. In states there are often obscure and almost latent causes, things which appear at first view of little moment, on which a very great part of its prosperity or adversity may most essentially depend."

And, he warns that good modeling and tested building blocks are essential. "[I]t is with infinite caution that any man ought to venture upon pulling down an edifice, which has answered in any tolerable degree for ages the common purposes of society, or on building it up again, without having models and patterns of approved utility before his eyes."

Burke's perspicacity is embodied in the US constitution, the Krebs cycle and genetic code, of the American state. The constitution created a *cas* that transformed a heritable process of government into an elective process.

[66] Arthur Koestler, The Lotus and the Robot (New York: MacMillan, 1961), 285.

[67] John T. Bonner, The Evolution of Culture in Animals (Princeton, NJ: Princeton University Press, 1980), 9.

[68] Dr. John Goss, III, discussion with author, 6 May 1999, Carlisle, PA.

[69] Bonner, 17.

[70] Ibid., 17-19

[71] Ibid., 147-148.

[72] Kelly, 306-307.

In a mathematical sense, Lamarckian evolution injects a bit of learning into the soup. Learning is defined as adaptation within an individual's lifetime. In classical Darwinian evolution, individual learning doesn't count for much. But Lamarckian evolution permits information acquired during a lifetime (including how to build muscles or solve equations) to be incorporated into the long-term, dumb learning that takes place over evolution. Lamarckian evolution produces smarter answers because it is a smarter type of search . . ..

The cleverness of . . . ants . . . is that the amount of information invested into "broadcasting" is very small, done very locally, and is very weak. The notion of introducing weak broadcasting into evolution is quite appealing. If there is any Lamarckism in earthly biology it is buried deep. But there remains a universe full of strange types of potential computation that might employ various modes of Lamarckian broadcasting. I know of programmers fooling around with algorithms to mimic "memetic" evolution—the flow of ideas (memes) from one mind to another, trying to capture the essence and power of cultural evolution.

[73] Ibid., 181-182.

[74] Bruce Waller, The Natural Selection of Autonomy (Albany: State University of New York Press, 1998), 7.

[75] J. Lee Kavanau, "Behavior of Captive White-footed Mice," Science 155 (1967): 162; quoted in Bruce Waller, The Natural Selection of Autonomy (Albany: State University of New York Press, 1998), 7.

[76] Waller, 8.

[77] Ridley, 313.

[78] Ibid., 322.

[79] R. Dawkins and J.R. Krebs, "Animal Signals: Information or Manipulation," In Behavioural Ecology, ed. J.R. Krebs and N.B. Davies (London: Blackwell, 1978), 282-309; quoted in Matt Ridley, The Red Queen (New York: Penguin Books, 1993), 334.

[80] Ridley, 175.

[81] Clark, The Global Imperative (Boulder, CO: Westview Press, 1997), 166. "Garret Hardin has coined the term 'ecolacy'

to be added to 'literacy' and 'numeracy' as one of the perspectives we need to appreciate our world. To the mastery of words literacy) and numbers (numeracy) he adds ecolacy, the mastery of connections." Compare with E.O. Wilson's elaboration of consilience as fused wisdom.

[82] Pinker, 453.

[83] Catherine Salmon and Martin Daly, "Birth Order and Familial Sentiment: Middleborns are Different" Evolution and Human Behavior 19, no. 5 (1998): 299-312.

[84] Donald Symons, The Evolution of Human Sexuality (New York: Oxford University Press, 1979); quoted in Steven Pinker, How the Mind Works (New York: W.W. Norton, 1997), 461. For further discussions see Deborah Blum's Sex on the Brain.

[85] Geoffrey F. Miller, "Sexual Selection for Protean Expressiveness: a New Model of Hominid Encephalization," paper delivered to the fourth annual meeting of the Human Behavior and Evolution Society, Albuquerque, NM, 22-26 July 1992; quoted in Matt Ridley, The Red Queen (New York: Penguin Books, 1993), 338.

[86] Ibid.

[87] Gregory Bateson, Steps to an Ecology of Mind: A Revolutionary Approach to Man's Understanding of Himself (New York: Ballantine Books, 1972).

[88] Pinker, 471-489.

[89] Ayres, 119.

[90] Koestler, 282.

[91] Ibid., 281-282.

[92] Betty Edwards, Drawing on the Right Side of the Brain, (Los Angeles: J.P. Tarcher, Inc., 1979), 40.

[93] Pinker, 370-373.

[94] Robert M. Sapolsky, Why Zebras Don't Get Ulcers (New York: W. H. Freeman & Co., 1998), 22.

[95] LeDoux, 126.

[96] David Quamman, Steven Pinker, Jonathan Wiener, and Peter and Rosemary Grant all discuss this phenomenon.

[97] LeDoux, 126-127.

[98] Pinker, 374.

[99] John Tooby and Leda Cosmides, "Evolutionary Psychology of the Generation of Culture: Part II, Case Study: A Computational Theory of Social Exchange," Ethology and Sociobiology 10, no. 1-3 (January 1989): 55-57.

[100] Pinker, 405-406.

[101] This brings to mind the restaurant scene in "When Harry Met Sally" where Meg Ryan groans and moans to prove to Billy Crystal that an orgasm can be faked. When she finishes her demonstration the little old lady in the table next to them orders "whatever she's having."

[102] Pinker, 406.

[103] Ibid., 409.

[104] Ibid., 411.

[105] Ibid., 412.

[106] Ibid., 412-413.

[107] LeDoux, 303.

[108] Pinker, 413.

[109] Barbara Tuchman, The Guns of August (New York: Ballantine Books, 1994), 1.

[110] Pinker, 494-495. Not quite so simple since there are duels to the death among animals. Dueling between humans is an outlawed part of this ritual of status and rank.

[111] Jack W. Bradbury and Sandra L. Vehrencamp, Principles of Animal Communication (Sunderland, MA: Sinauer Associates, 1998), 630-645. The bottom line is that animals don't reach pareto optimums—they lie, cheat, arm, seduce, court and fight selfishly.

[112] Ibid., 496.

[113] Ibid., 497.

[114] Ibid., 497-498.

[115] Anatol Rapoport, The Origins of Violence (New Brunswick, NJ: Transaction Publishers, 1995), 186-190.

The statement of McKinley's assassin may well speak for all of them: "I have done my duty. The President was the enemy of the workers. He went about saying that the whole nation is prospering. He was a liar. I believe we should not have leaders. It is right to kill them. I am an anarchist."

[116] Rapoport, 187. The prevalence of ideological terrorism in Italy, Spain, and Russia during the nineteenth century and its comparative rarity in Germany and England can be ascribed to the fact that the misery of the victims of the Industrial Revolution in the northern countries was to some extent alleviated by reforms and by gradual introduction of social services, especially in Germany, which at the height of its imperial power had the most advanced system of social welfare in Europe. All the more remarkable is the resurgence of ideological terrorism at a time when the economic reconstruction of Europe after World War II was completed.

[117] Pinker, 395-396. Criminality is a 'rational' response to a chaotic environment. Humans also posses a trait called 'myopic discounting' where the brain flip-flops between a large but distant in time reward and a small but near in time reward. The closer a man gets to the small reward the more the far-off but large reward becomes discounted.

[118] Victor Alexandrov, Journey Through Chaos (New York: Arco Publishing, 1945), 168.

[119] Ibid. Is this what happens when an entire society runs amok?

[120] Murray Feschback, Ecological Disaster (New York: Twentieth Century Fund Press, 1995), 63-66.

[121] Alexandrov, 363-364.

[122] B.B. Burton-Bradley, quoted in M. Daly and M. Wilson, Homicide (Hawthorne, NY: Aldine de Gruyter, 1988), 281; quoted in Steven Pinker, How the Mind Works (New York: W.W. Norton, 1997), 364.

[123] Lionel Tiger and Robin Fox, The Imperial Animal (New York: Holt, Rinehart and Winston, 1971), 193.

[124] Ibid.

[125] Marshall, 183.

In June, 1944, Lieutenant Woodrow W. Millsaps led a patrol . . . [during] a night action . . .. Though the men had volunteered for the duty, all were in a peculiarly desperate state of mind before the start. For three days the battalion had been surrounded by enemy forces; within the perimeter men were dying for want of plasma, and the wounded were suffering more acutely because of the lack of water; their cries of distress had so demoralized the able-bodied men that Millsaps welcomed the chance to get away from the hill.

At the foot of the hill an enemy machine gun opened fire on the patrol but the bullets went high. The men broke and "ran like dogs." Millsaps and a sergeant beat them back with physical violence. After they were again collected. Millsaps lost almost an hour, alternately bullying and pleading with them before they would go forward.

At last they charged the enemy, closing within hand-grappling distance. The slaughter began with grenade, bayonet and bullet. Some of the patrol were killed and some wounded. But all now acted as if oblivious to danger. The slaughter once started could not be stopped. Millsaps tried to regain control but his men paid no heed. Having slaughtered every German in sight, they ran on into the barns of the French farmhouses where they killed the hogs, cows, and sheep. The orgy ended when the last beast was dead.

[126] Ibid., 194.

[127] Leonard Piekoff, The Ominous Parallels (Briarcliff Manor, NY: Stein and Day, 1971), 259.

[128] Ibid.

[129] Ibid., 269.

[130] Ibid.

[131] Dave Grossman, On Killing (Boston: Back Bay Books, 1996), 304.

[132] Pinker, 364.

[133] Torah, 1224.

[134] David C. Scott, "Middle Paleolithic: 100,000 - 30,000 BC," available from <http://www.interoz.com/egypt/ebph2.htm>; internet; accessed 1 February 1999.

Oddly though, almost as soon as this protoagriculture was developed, it appears to have been abandoned. Beginning around 10,500 BC, the stone sickles that were so predominant seem to simply fade out of the picture and there is a return to the hunter-gatherer-fisher culture that came before. Invasion by another people is a possible explanation, though a series of natural disasters that devastated the fledgling crops is more logical, as we are dealing with abandonment by not one, but many prehistoric societies over a widespread area. At first it would seem that the growing aridity of the environment was the cause. Certainly, given the present state of the Sahara and the surrounding area, this is a logical conclusion, but new evidence shows that this period was marked by a series of rather severe and violent Nile floods which could have destroyed the "farmlands" and discouraged the people from continuing to rely on crops as a dietary index.

It was about this time that the demise of the various Paleolithic peoples in Egypt began. It may very well be that the abandonment of protoagriculture contributed to this, but the discovery of the Jebel Sahara cemetery sheds some new light on the end of many Paleolithic cultures. In all, three Qadan cemeteries are known: one at Tushka, and two at Jebel Sahara, one on each side of the river. Although many of the remains unearthed at these sites are the usual cross-section of elderly and young, chieftains and commoners, there are quite a disturbing number of bodies from the final 10,000 years of the Upper Paleolithic that appear to have died by violence. Stone points found with the remains were almost all located in areas of the body that suggests penetration as spear points or similar weapons. Most were located in the chest and back area, with others in the lower abdomen, and even a few entering the skull through the lower jaw or neck area! Additionally, the lack of bony calluses as a result of healing near these points shows that in many of these cases the wound was fatal (bone tissue repairs itself rather quickly, preliminary healing often begins before even that of soft tis-

sues). A statistical analysis of the main cemetery at Jebel Sahara gives a figure of 40 percent of the people buried there died from wounds due to thrown projectiles: spears, darts, and arrows.

Why then was a hunter-gatherer culture so prone to violence? One explanation is diminishing resources, caused by the growing aridity and the failure of the protoagriculture experiments. The Jebel Sahara cemeteries must only have been used for a few generations and for that many violent deaths to occur within that time supports an explanation based on massive intertribal warfare. Also, since the victims were of all ages (except infants; only one infant is buried in each of the Jebel Sahara cemeteries), this could indicate that the majority of the skirmishes were actually based on raiding and ambush, as "normal" warfare usually only involves young to middle-aged males. And we should not dismiss the possibility of invasion by a more advanced, or at least more powerful, people from outside, especially if Jebel Sahara and similar sites date to as late as 7000 BC, as by then the people would have been in competition with larger and more advanced Epipaleolithic cultures.

[135] M. Daly and M. Wilson, Homicide (Hawthorne, NY: Aldine, 1988), ix; quoted in Steven Pinker, How the Mind Works (New York: W.W. Norton, 1997), 434-435.

[136] Ibid., 514-515.

[137] Ibid., 510.

[138] Dudley Young, Origins of the Sacred: The Ecstasies of Love and war (New York: Harper Perennial, 1992), 82; quoted in Barbara Ehrenreich, Blood Rites (New York: Metropolitan Books, 1997), 54.

[139] Lawrence H. Keeley, War Before Civilization: The Myth of the Peaceful Savage (Oxford: Oxford University Press, 1996), 75.

[140] Pinker, 510. Keeley 86-87, notes the same phenomenon.

[141] David M. Buss, Evolutionary Psychology (Boston: Allyn and Bacon, 1999), 304.

[142] Ibid.

[143] Ibid.

[144] Ibid.

[145] J.M.G. Van der Dennen, The Origin of War (Groningen: Origin Press, 1995), 593.

[146] Ibid., 539-594. Contains an excellent discussion of the evolution of coalition warfare.

[147] John Tooby and Leda Cosmides, "Evolutionary Psychology of the Generation of Culture: Part II, Case Study: A Computational Theory of Social Exchange," Ethology and Sociobiology 10, no. 1-3 (January 1989): 51.

[148] Buss, 301.

[149] Buss, 302.

[150] Pinker, 478.

[151] Napoleon A. Chagnon, Yanomamö: The Last Days of Eden (San Diego, CA: Hartcourt Brace & Co., 1992), 236-238.

So even he [Hukoshikuwä] was not enthusiastic about the raid, despite his lecture to the younger men about their reluctance and cowardice. He was older, however, and had to display the courage that all adult Yanomamö men are supposed to show. In short, although Hukoshikuwä probably had little desire to participate in the raiding, he was obliged to do so by the pressures of the system. He could ill afford to remain neutral, for his very on kinsmen—even Kaobawä—had implied by word and action that they were disgusted with him for not having avenged the death of his brother. Some of his kinsmen in other villages had openly accused him of cowardice for not having chased the raiders who shot Matowä. His erstwhile allies, when they complained about having to feed him and his relatives, were blunt and discourteous. The Shamatari allies had even demanded a number of women from Hukoshikuwä's group, in payment for girls the allies had given his group much earlier, when the Monou-teri were high in the alliance pecking order. If Hukoshikuwä failed to put on a show of military determination and vindictiveness, it would not be long before his friends in allied villages would be taking even greater liberties and demanding even more women. The system worked against him and demanded that he be fierce, whether he wanted to be or not. Since his group was small, it had to protect its sovereignty all the more rigorously, or be absorbed by a greedy ally whose protection would be tendered at the price of women.

[152] Williamson Murray, Arthur J. Corbett, Charles R. Ball and Montgomery Warner, conversations with author, 10-11 May 1999, Carlisle, PA. Marine Corps 'Speed-March-Reaction' and Army 'Leader-Reaction' courses are based on 1920's German Werhmacht psychological aptitude tests using physical obstacles and hindrances which a small group must solve. The purpose is not to get a solution, but to observe teams perform under stress. Prof. Murray points out that all-male teams tend to action whereas all-female teams tend to ponder. The best mix seems to be three men and one woman. M. Warner points out "that's an insect colony." A. Corbett notes similar results and says that it stems from conceptual versus instructional approaches that if available benefit the team.

[153] Frank Muscarella and Michael R. Cunningham. "The Evolutionary Significance and Social Perception of Male Pattern Baldness and Facial Hair," Ethology and Sociobiology 17, no. 2 (1996): 99-117.

[154] Manfred Hassebrauck, "The Visual Process Method: A New Method to Study Physical Attractiveness," Evolution and Human Behavior 19, no. 2 (1998): 112. A male waist-to-hip ratio (WHR) of 0.9 tends to correlate with health, whereas a 0.7 WHR for females indicates higher circulatory estrogen and likelihood of fertility. He also notes that men look at more female features and complete their scans faster than women do theirs. The most frequently scanned body parts in order of priority are eyes, mouth, hair, nose, upper body and chin.

[155] Marshall, 42.

I hold it to be one of the simplest truths of war that the thing which enables an infantry soldier to keep going with his weapons is the presence or the presumed presence of a comrade.

[156] Oakley Ray and Charles Ksir, Drugs, Society and Human Behavior (Boston: WCB McGraw-hill, 1999), 249.

The correlation between alcohol use and homicides is well known to police and judicial systems all around the world. Based on several studies of police and court records, the proportion of murderers who had been drinking before the crime ranged from 36 percent in Baltimore to 70 percent in Sweden. It is also interesting that across all these studies, about 50 percent of the murder victims had been drinking.

[157] James M. Dabbs, E-Lee Chang, Rebecca A. Strong and Rhonda Milun, "Spatial Ability, Navigation Strategy, and Geographic Knowledge Among Men and Women," Evolution and Human Behavior 19, no. 2 (1998): 91.

[158] West, 3.

Her question made me remember that the word 'idiot' comes from a Greek root meaning private person, Idiocy is the female defect: intent on their private lives, women follow their fate through a darkness deep as that cast by malformed cells in the brain. It is no worse than the male defect, which is lunacy: they are so obsessed by public affairs that they see the world as by moonlight, which shows the outlines of every object but not the details indicative of their nature.

[159] Clausewitz, 76.

. . . it would be an obvious fallacy to imagine war between civilized peoples as resulting merely from a rational act on the part of their governments and to conceive of war as gradually ridding itself of passion, so that in the end one would never really need to use the physical impact of the fighting forces . . .

[160] Pinker, 513.

[161] Levine, 234.

Inbred strains of laboratory mice, for example, exhibit marked differences in aggressive behavior that can be measured by rigorous, carefully controlled tests. Numerous researchers, certain that these differences result from genetic variations among strains, are conducting elaborate experiments to map and identify alleles behind them. Those experiments involve cross-breeding strains with different levels of aggression and "back-crossing" resulting hybrids (breeding them back to one or the other of their parents) to identify genetic markers associated with aggressive behaviors.

Nonetheless, researchers who have dedicated their professional lives to document the influence of genes on behavior know that they must monitor their subject's environment with precision that an outsider might consider positively obsessive. Why? Because the behavior of an individual mouse in a test can be affected by the time of day and season of the year at which testing is performed, the amount of light in the home cage and test arena, the size of the test arena, and the duration of the test. Mice transferred from cage to cage with forceps behave less aggressively than those carried around in small boxes. Males

reared in the presence of an adult male have higher levels of offensive aggressive behavior that those reared by their mother alone. The number of littermates a mouse had, the number and type of animals it has been housed with, and the nature of its food and drink can also influence levels of aggression. In fact, environmental influences begin in the womb itself: male fetuses positioned in the uterus between two brothers score higher in certain aggressiveness tests than fetuses surrounded by sisters.

What's the message here? Can genes exert demonstrable influence on aggressive behavior in strains of mice? Substantial evidence indicates that they can. Does a particular combination of genes determine irrevocably the way an individual mouse will behave? Not on your life! "Genetic influence," "environmental influences," and "gene-environment interactions" are statistical terms determined by the study of groups of individuals. As mouse researchers know, observation of genetic effects on populations (groups of mice) are not easily translated into predictions of the way an individual mouse with a particular genetic makeup will behave in a given situation at a specific time. This difficulty is one reason why, after almost fifty years of work, mouse researchers still know little or nothing about specific genes involved in aggressive behavior, know those genes interact during development, or how they change as behavior evolves in various strains. And they are nowhere near isolating a specific "aggression gene."

[162] Ibid., 305.

[163] Pinker, 422.

[164] Ibid., 423-424.

[165] Peter Calvert, Revolution and Counter-Revolution (Minneapolis: University of Minnesota, 1990), 76.

[166] West, 13.

[167] McNeill, Plagues and People, 83 and 118-119.

[168] David S. Landes, The Wealth and Poverty of Nations (New York: W.W. Norton, 1998), 37.

[169] David Herlihy, The Black Death and the Transformation of the West (Cambridge, MA: Harvard University Press, 1997), 56.

[170] McNeill, Plagues and People, 81-82.

[171] J. Bronowski, The Ascent of Man (Boston: Little, Brown and Co., 1973), 436.

Our actions as adults, as decision makers, as human beings, are mediated by values, which I interpret as general strategies in which we balance opposing impulses. It is not true that we run our lives by any computer scheme of problem solving. The problems of life are insoluble in this sense. Instead, we shape our conduct by finding principles to guide it. We devise ethical strategies or systems of values to insure that what is attractive in the short term is weighed in the balance of the ultimate, long-term satisfactions.

[172] Ayres, 204. Ayres's analogy of culture (software) and man (hardware) is interesting but misses the emotional element:

It is not too misleading to think of knowledge manifest in labor skills as a set of programs for a biological computer (the brain) operating a general-purpose, self-aware machine (the body). General education starting with infancy provides the comprehensive internal world-model and data base; eyes, ears, and hands constitute the external monitoring system, while job-related training provides the specific operating programs for controlling processing equipment, handling tools, driving vehicles, or carrying out other functions.

[173] Arthur L. Dahl, The Eco Principle (London: Zed Books, 1996), 158-160.

There are sufficient models in nature, of the proven effectiveness of complex systems like ours, for us to imitate their features with some hope of success. We can be reasonably optimistic about the inherent resilience and creativity in human society, and about the ability of democratic consultative institutions with adequate checks and balances to guide the process. The main challenge is to establish a foundation of shared values sufficiently strong to ensure cohesiveness and to counteract the negative and destructive tendencies in present-day society....

We are feeling our way along towards a new society, and shall need to experiment on a small scale, and in particularly propitious situations, until we have established some confidence in the directions we are taking. The real danger is in the immobilism that could come from the fear of any change, or the sense of helplessness at the complexity of the situations we face....

The theory of ecos provides a unifying framework explaining the workings of all functional systems, including our own, and

bringing together the economic, environmental, social and even spiritual dimensions of our society. It shows the importance of achieving and maintaining a balance in all material inputs to, and outputs from, an eco. In particular, it demonstrates the importance of the information held within a system and determining its structure and the extent of its connectivity and integration, as well as the way the flow of energy driving an eco can assist in building its information content. This information is in fact the true wealth of all ecos, including those of human society. Redefining, the most important wealth as that of information can help us to break out of the present materialistic world-view, which dominates so much current thinking, and to consider some visions of the future....
The transformation of social institutions starts with the family and extends to communities at all levels....

The community values necessary are unity in diversity, equality, collaboration, conciliation, and a sense of our collective responsibility for the welfare of every human being. The basic operating principles will be participation and consultation.

[174] Theodore Caplow and Louis Hicks, Systems of War and Peace (Lanham, MD: University Press of America, 1995), 241.

[175] David H. Fischer, The Great Wave (Oxford: Oxford University Press, 1996), 246-251.

[176] Leonard Piekoff, The Ominous Parallels: The End of Freedom in America (Briarcliff Manor, NY: Stein and Day, 1982). Piekoff argues that a philosophy and culture of irrationality and anti-intellectualism guided totalitarianism—the secret police and concentration camps were part of a system of ideas.

[177] Robert D. Kaplan, "The Coming Anarchy," February 1994; Available from http://www.theatlantic.com/atlantic/election/ connection/foreign/anarcf.htm; Internet; Accessed 24 February 1999.

[178] West, 835.

[179] Manuel de Landa, War in the Age of Intelligent Machines (New York; Zone Books, 1991), 6-7.

The self-organizing processes studied by the science of "order out of chaos" (or "chaos," for short) have indeed changed the way scientist view organic matter. While at one time only biological phenomena were considered to be relevant for a study of evolution, now inert matter has been found to be capable of

generating structures that may be subjected to natural selection. It is as if we had discovered a form of "non-organic life."

With this in mind, I have borrowed from the philosopher Gilles Deleuze the concept of the "machinic phylum," the term he coined to refer to the overall set of self-organizing processes in the universe. These include all processes in which a group of previously disconnected elements suddenly reaches a critical point at which they being to "cooperate" to form a higher level entity. To provide a clearer idea of what these processes of spontaneous "cooperative behavior" are, consider a few examples: the individual spin of atoms in a metal "cooperate" to make the metal magnetic/ the individual molecules in a chemical reaction "cooperate" to create the perfectly rhythmic patterns of a chemical clock' the cells making up an amoeba colony "cooperate" under certain conditions to assemble an organism with differentiated organs; and the different termites in a colony "cooperate" to build a nest. On the face of it, there would be no reason to assume that processes as different as these could be related at a deeper level. But recent advances in experimental mathematics have shown that the onset of all these processes may be described by essentially the same mathematical model. It is as if the principles that guide the self-assembly of these "machines " (e.g., chemical clocks, multicellular organisms or nest-building insect (colonies) are at some deep level essentially similar.

This conclusion, that behind self-organization there is a " machinic phylum," that behind the spontaneous emergence of order out of chaos there are deep mathematical similarities, would hardly escape the notice of our hypothetical robot historian. After all, the emergence of "robot consciousness" could have been the result of such a process of self-organization. Such processes, as we will see, have in fact been observed in large computer networks (an in small neural nets). Furthermore, the notion of a machinic phylum blurs the distinction between organic and non-organic life, which is just what a robot historian would like to do. From its point of view, as we have seen, humans would have served only as machines' surrogate reproductive organs until robots acquired their own self-replication capabilities. But both human and robot bodies would ultimately be related to a common phylogenetic line: the machinic phylum.

Order emerges out of chaos, the robot would notice, only at certain critical points in the flow of matter and energy: when a critical point in the concentration of a chemical is reached, the termite colony becomes a "nest-building " machine; when available food reaches a (minimum) critical value, the amoebas

self-assemble into an organism; when critical points in the rate of reaction and diffusion are reached, molecules spontaneously come together to form a chemical clock; and at a critical point in speed, the random flow of a moving liquid gives way to the intricately ordered patterns of turbulence. Robotic, or machinic, history would stress the role of these thresholds (of speed, temperature, pressure, chemical concentration, electric charge) in the development of technology. Human artisans would be pictured as tapping in to the resources of self-organizing processes in order to create particular lineages of technology.

[180] Mike Giuliano, "The Soul and the Silicon Chip, A Keynote Lecture by Ray Kurzweil, Guru of the Computer Age," Peabody News, January/February 1999, 9.

[181] Pinker, 565.

[182] Pinker, 518-519.

[183] Pagels, 333-334.

[184] Ibid.

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